In the following section you will find descriptions of departments and programs, with their degree requirements and lists of their faculty. Descriptions of courses can be found online at \url{http://go.tufts.edu/sis}.

Detailed course descriptions can also be found in handbooks issued by individual departments and programs. These handbooks often describe courses not listed in the online bulletin.

Courses numbered 1 through 99 are for undergraduate credit only; those numbered 100 through 199 are for both undergraduate and graduate credit; those numbered 200 through 299 are intended primarily for graduate credit, although undergraduates may take these courses for credit with the permission of the instructor and/or department.
Africana Studies

DIRECTOR:
Professor H. Adlai Murdoch, Romance Languages

Africana Studies Major

Africana Studies is an interdisciplinary field that focuses on the people of the African continent and people of African descent in the global African Diaspora. The Africana Studies major exposes students to the historical, political, social, economic, and cultural systems and institutions that frame the lived conditions and experiences of Africana peoples in the countries of the African continent and in its diasporic populations. In addition, Africana Studies critically interrogates the various socio-historical contexts in which racialized western epistemologies developed, while examining such neglected areas of study as the important contributions to human labor, political and cultural expression, social development, and science and industry made by people of African descent in the modern era. Africana Studies offers an interdisciplinary approach to the philosophical foundations of knowledge production and highlights the complex interaction between resistance, identity and culture in providing an enabling context for a range of identititarian expressions by Africans and peoples of African descent. It also provides a critical approach to selected historical, social and cultural processes that are essential to an enhanced understanding of contemporary globalization.

Africana Studies as it is structured today grew out of the curricular transformation generated by the international process of decolonization and by the changes wrought by the civil rights and Black Power eras that called for social, political, and economic justice in the United States and abroad and demanded a more diverse and inclusive educational agenda. As also is true for the related fields of Asian American Studies and Latino Studies, the field has grown and expanded since its origins more than four decades ago. Africana Studies in the contemporary era incorporates varied disciplinary and interdisciplinary approaches, but retains its distinctive focus on social justice. The field also highlights key moments of black resistance and revolution as well as 19th and early- and mid-20th century intellectual movements focusing on various political, linguistic, and cultural factors undergirding the experiences of peoples of Africa and its global diaspora.

The goal of an in-depth study of Africa and the African Diaspora is the development of critical thinking, research, and writing skills that emerge from an increased awareness of the political, social, cultural, and historical roles played by peoples of African descent as well as the socio-political and economic challenges that continue to be faced by that global community. The primary goal of the program is to give students a broader and more contextualized understanding of the scope and substance of the black experience in a variety of related areas. Graduates of Africana Studies Programs go on to careers in academia, government, education and public service. The intellectual skills acquired in this discipline are also an excellent preparation for careers in public health, public policy and urban planning, journalism, law and criminal justice, business, and the international sector.

UNDERGRADUATE CONCENTRATION REQUIREMENTS

The major in Africana Studies consists of ten interdisciplinary and disciplinary courses drawn from the interrelated fields of African studies, African Diaspora studies, African American studies, and courses focused on comparative studies or topics relevant to Africana studies. Students declaring an Africana Studies major in AY 2017 and beyond will pursue the major according to the following structure:

Two core courses

Category I: One Introductory course, drawn from the following circulating courses: Introduction to Africana Studies; WEB DuBois and the Foundations of Africana; A World View of Race; Black World Literature.

Category II (Methodology and Concentration): a course drawn from the following courses: Race and US Africa Policy; Black Feminist Theories; African Politics; Youth of Color; Critical Race Theory; African History; History of African-American Music
Eight elective courses
Category III (Distribution/Electives): at least five of these courses should come from the student’s main area of concentration (drawn from the designated areas Africa, African America, and Other Diasporas). The other three should be selected from the other two areas, at least one from each.

Africana Studies majors are encouraged to fulfill their foreign language requirement in a language of Africa or the African Diaspora, e.g., Twi, Swahili, or Arabic, or one that will assist work in areas of Africa or the Diaspora, e.g., French, Portuguese.

Majors in Africana Studies may take up to five courses that are also counted towards another major. Up to four courses may be transferred from other institutions (e.g. non-Tufts programs abroad). At least three courses of the major must be at the 100 level. Up to two courses of independent study (including senior honors thesis) may be counted towards the major. Courses with grades lower than C- will not be accepted towards the major. The foregoing is a minimal program. For many purposes further preparation involving additional language and additional 100-level courses is needed.

Africana Studies Minor
The Africana Studies Minor requires six disciplinary and interdisciplinary courses drawn from African studies, African Diaspora studies, African American studies, and comparative studies or topics relevant to Africana studies. Of these six courses, four are core courses and two are electives.
1. Two core courses as outlined for the major.
2. Four elective courses drawn from any two of the elective options for the major.

Students are encouraged to declare their interest in an Africana Studies minor not later than the beginning of their senior year. One elective may be an independent study course (including senior honors thesis); three courses may be counted towards a major; normally up to two courses may be transferred from other institutions. At least one course of the minor must be at the 100 level. Courses with grades lower than C- will not be accepted towards the minor.

For more detailed information, please visit the website http://ase.tufts.edu/africanastudies/.
American Studies

DIRECTOR:
Professor Heather Curtis, Religion

FACULTY:
Professor Pawan Dhingra, Sociology
Professor Lisa Lowe, English
Associate Professor Jennifer Allen, Public Health and Community Medicine
Associate Professor Helen B Marrow, Sociology
Associate Professor Natalie Masuoka, Political Science
Associate Professor Stephan Pennington, Music
Associate Professor Sarah Sobieraj, Sociology
Associate Professor Ichiro Takayoshi, English
Associate Professor Greg Thomas, English
Associate Professor Sabina Vaught, Education
Associate Professor Monica White Ndounou, Drama and Dance
Associate Professor Adriana Zavala, Art and Art History
Assistant Professor Alexander Blanchette, Anthropology
Assistant Professor Kendra Field, History
Assistant Professor Noe Montez, Drama and Dance
Assistant Professor Cora Roelofs, Community Health
Visiting Assistant Professor Matt Hooley, American Studies/Native American Studies
Senior Lecturer Steven D. Cohen, Education
Senior Lecturer Cathy Stanton, Anthropology
Senior Lecturer Jean Wu, American Studies
Lecturer Thomas Abowd, American Studies/Colonialism Studies
Lecturer Ronna Johnson, English/American Studies

The American Studies program is part of the Consortium of Studies in Race, Colonialism, and Diaspora. American Studies is an interdisciplinary field that studies the paradigmatic narratives that shape our received understandings of the American past and present. American Studies considers contexts such as settler colonialism, slavery, labor, capitalism, immigration and war, all of which have influenced the ideas, history, culture and society of the United States. Students examine how political, economic and social differences inform and are reproduced by institutions and in public areas such as the law, education, work, health and the environment. Students attend to the intersecting dynamics of race, class, religion, region, gender and sexuality, and consider how these dynamics are mediated by literature, music, the visual arts and popular culture.

UNDERGRADUATE CONCENTRATION REQUIREMENTS
To graduate with a Bachelor of Arts degree in American Studies, a student must complete ten courses, including one Foundation course (AMER 10-20); one Integrative Seminar (AMER 170-189); one History course with at least two-thirds of course content focused on some aspect of the U.S.; and five credits that form a thematic interdisciplinary cluster, including at least two courses at the 100+ level and representing two disciplines or more. Beyond these eight courses there are then three options to complete the major: 1) A student may propose a Senior Special Project, completed in the fall semester, and one elective course, both pertinent to their cluster. 2) A student may propose an Honors Thesis, taken in both semesters of the senior year, which integrates or expands some aspect of the student’s cluster; or 3) A student may opt or be advised to complete the major requirements by taking an additional integrative seminar (AMER170-189), pertinent to their cluster, in substitution of the SSP or HT.

Note: AP courses may not count toward the American Studies major. A grade of C- or better is required for a course to count toward the major. No more than ONE independent study course or internship will count toward the cluster. Internships for credit must be supervised by an American Studies faculty member and pre-approval must be granted by the program director.

The director and faculty advisors work closely with students in tailoring individual programs reflecting particular interests and providing a framework for the continued integration of knowledge at more advanced
levels. The American Studies program office is located at 110 Eaton Hall. For more information, call 617-627-2311, visit http://as.tufts.edu/americanStudies, or e-mail the program administrator, cyn-thia.sanders@tufts.edu.
Anthropology

Professor David M. Guss, Urban and aesthetic anthropology, placemaking, cultural performance, myth and ritual, popular culture; Latin America

Associate Professor Stephen M. Bailey, Biological and nutritional anthropology; growth and body composition, methodology; the Americas, China

Associate Professor Amahl Bishara, Media, human rights, the state, journalism, democracy, the politics of place, knowledge production; the Middle East

Associate Professor Sarah Pinto, Medical anthropology, gender, mental health, reproduction, cultures of biomedicine, kinship, body, global feminism; India

Associate Professor Rosalind H. Shaw, Memory, violence, temporality, post-conflict, transitional justice, children & youth; West Africa

Assistant Professor Alex Blanchette, Ecology, labor, green capitalism, biotechnology, animals, modernity, alienation, food politics, industrial agriculture; USA

Assistant Professor Tatiana Chudakova, Medical anthropology, science & technology, environment, ethnicity, indigeneity, nationalism, post-socialism; Russia, North Asia

Assistant Professor Nick Seaver, Computing, algorithms, sound, music, knowledge, attention, taste, classification, media technologies, science & technology studies

Senior Lecturer Cathy Stanton, Tourism, museums, myth & ritual, cultural performance, culture-led redevelopment, mobilities, farm history/heritage

Professor Emeritus Deborah Pacini Hernandez, Comparative Latino Studies, racial and ethnic identity, popular music, globalization; Latino community studies

Anthropologists study global human experience, combining social, cultural, biological, archaeological, and linguistic approaches within a single discipline. Our questions and topics are diverse, including (for example) the relationship between power and culture, how human bodies relate to their environments, and the study of social distinctions through archaeological methods. While in the past anthropology was typically the study of non-Western societies, today anthropologists also work “at home”—wherever in the world that “home” is. Ethnography, cultural anthropology’s signature set of research methods, helps researchers view social interactions and cultural practices with new eyes, and is in demand in the workplace. This combination of disciplinary breadth, global and local understanding, and hands-on research makes Anthropology a strong major and an excellent preparation for a wide range of careers.

UNDERGRADUATE CONCENTRATION REQUIREMENTS

Major in Anthropology
Ten courses, including: one gateway (introductory level) sociocultural anthropology course (Anthropology 10-39); one gateway biological anthropology or archaeology course (Anthropology 40-59); Anthropology 130; and seven additional anthropology courses, at least one of which must be an area focused course numbered below 160, and two of which must be upper-level seminars (Anthropology 160-189).

Please note: We recommend taking the theory course (Anthropology 130) in the junior year. The department encourages majors to explore the possibility of undertaking an internship (Anthropology 99) or independent study (Anthropology 191-199). A minimum of 50% of courses counted toward the Anthropology major must be completed at the Tufts University home campus or in Tufts University-sponsored programs abroad. A maximum of two courses cross-listed in other Tufts departments may be counted toward the Anthropology major. Students must achieve a grade of C- or better for a course to count for credit toward the major.

For more detailed information, please visit the website http://ase.tufts.edu/anthropology.
Applied Mathematics

(FOR DEGREE REQUIREMENTS, SEE Mathematics.)
Applied Physics

(FOR DEGREE REQUIREMENTS, SEE PHYSICS and astronomy.)
Arabic

(SEE GERMAN, RUSSIAN, AND ASIAN LANGUAGES AND LITERATURES.)
Our understanding of the majority of the human past, for which the written record is nonexistent or minimal, is based on a material record. Archaeology examines this record of human activity to recover and interpret information about past societies and cultures. There are many subdisciplines within archaeology, reflecting both the specific periods and regions into which we divide the human past, and the different approaches to the recovery and analysis of the evidence about that past.

Tufts offers a general interdisciplinary undergraduate major in archaeology, incorporating courses from the arts, humanities, natural sciences, and social sciences. Ideally, a student in archaeology will combine course work with firsthand experience in recovery, conservation, and interpretation of material remains.

The archaeology program is affiliated with the Center for Materials Research in Archaeology and Ethnology (CMRAE) based at M.I.T., an alliance of Boston-area programs that offers specialized course work in the scientific dimensions of archaeological study. Students are encouraged to take appropriate course work at the universities affiliated in the Boston Consortium (Boston College, Boston University, Brandeis University).

UNDERGRADUATE CONCENTRATION REQUIREMENTS
The undergraduate major consists of eleven courses, including a core of four required courses plus a selection of seven elective courses distributed among three broad subject areas. Students are advised to complement their archaeology major with a second major or a minor in a related field. Archaeology majors are strongly encouraged to pursue some independent research project or field research component in archaeology either as part of a senior thesis or a summer scholar’s project. This can include, among other things, participation in excavations, museum work, archaeological preservation, etc.

Eleven to thirteen courses distributed as follows:
I. Four courses in core curriculum:
   1. Anthropology 39 (may substitute ANTH 20 or 27)
   2. Archaeology 30 (cross-listed as ANTH 50; formerly ANTH 30)
   3. Archaeology 27 (cross-listed as CLS 27 and FAH 19)
   4. Earth and Ocean Sciences 2

II. Seven courses from History, Natural/Social Sciences and Archaeology. (Only courses which have direct content, theoretical, or technical relevance to archaeology are included here. However, other courses in History, the Natural Sciences, and Archaeology may be considered for inclusion if approved by a faculty advisor in the archaeology program. Transfer courses from other institutions limited to two unless approved by advisor.)
   a. Two History courses taken from CLS 26, 37, 38, 47, 85, 86, 142, 143, 144, 146, 147, 185, 186; HIST 6, 13, 17, 23, 40, 50, 51, 72, 76, 105, 148, 149, 151
   b. Two Natural/Social Science courses taken from ANTH 40, 49 (formerly 20), 126, 132, 150, 182; Biology 7 or 10 (student may not count both BIO 7 and BIO 10), 143, 144; CHEM 2, 8; EOS 32

III. Interdisciplinary Capstone (optional)—Archaeology 193 and 194 or other approved courses
GRADUATE PROGRAM

Master of Arts in Classical Archaeology

(SEE CLASSICS FOR PROGRAM DESCRIPTION.)

For more detailed information, please visit the website http://ase.tufts.edu/archaeology.
Architectural Studies

DIRECTOR (2016–2017):
Professor Peter Probst, Art and Art History

Tufts offers several curricular paths for students interested in the study of architecture and the built environment. The various curricular paths in architectural studies provide opportunities to study architecture as a liberal arts or engineering major or minor and, if desired, help prepare for future graduate study and careers in architecture and other allied disciplines, such as landscape architecture, urban planning, and historic preservation. All the curricular paths emphasize architecture’s interdisciplinary character and take full advantage of course offerings in both the College of Liberal Arts and the School of Engineering.

In addition to the courses of study outlined below, students interested in pursuing graduate studies in architecture should take one or two semesters of calculus (Mathematics 32-34) and physics (Physics 11-12), and are encouraged to take Drama 10 for public speaking.

For more information, contact Professor Daniel Abramson (Art and Art History) or Professor Masoud Sanayei (Civil and Environmental Engineering).

COLLEGE OF LIBERAL ARTS

Major in Architectural Studies
The Department of Art and Art History offers an interdisciplinary major in Architectural Studies for students in the College of Liberal Arts that teaches students understanding of the built environment from multiple perspectives through the development of basic skills in analyzing, interpreting, engineering, designing, and engaging imaginatively and actively with the current and historical built environment.

The built environment is defined broadly, from stage scenery and interior design to civil engineering and urban planning, in order to reflect historical and contemporary experience and to encompass the richness of Tufts’ curricular assets, which besides the offerings of the Art and Art History Department, include the university’s School of Engineering, its graduate department in Urban and Environmental Policy and Planning, and its affiliation with the School of the Museum of Fine Arts. The Architectural Studies major totals twelve courses: seven core classes and five multidisciplinary electives. The major’s core curriculum provides a foundation in art and architectural history and theory, in engineering and design, and in the humanistic and social science aspects of architecture. Architectural Studies majors then design their own elective program of upper-level study from designated courses in architectural history, studio art, civil engineering, the humanities, and the social sciences. (Students may take no more than three half-credit courses towards the major’s requirements.) As a capstone, senior majors in their final semester complete a senior integrative project, either as an independent research project or an internship in a professional office. Several opportunities exist for study abroad. Completion of an intensive summer architectural design course from an accredited architecture school (e.g., Career Discovery at Harvard’s Design School) exempts majors and minors from the FAM 22 requirement. For more information see http://ase.tufts.edu/art/architecture/.

Required Core Curriculum
1. Art History 8 Introduction to Architecture, 1400 to the Present
2. Art History 1 Introduction to World Art I
3. FAM 22 Design: Architectural
4. Engineering/Technology core course: Engineering 1-08, 5, 23, 39, or 80; or Engineering Psychology 61; or Engineering Science 5, 18, 25, or 27; or GIS 101
5. Humanities/Social Sciences core course (Asterisked [*] course from Area C below)
6. Upper-level architectural history class (FAH 115, 120, 123, 125, 126, 127, 190, 191, 192, 193, 195, 196, or 198 [architecture]; or 193; or CE 120)
7. Art History 98 Architectural Studies Senior Project Seminar

Multidisciplinary Electives
Five courses chosen from at least three of the following four disciplinary areas.
A. Architectural and Art History
B. Studio Art
C. Humanities and Social Sciences
D. Engineering and Technology

A. ARCHITECTURAL AND ART HISTORY
Archaeology 26 Ancient Egypt
Art History 2 Introduction to World Art II
Art History 15/115 Japanese Architecture
Art History 19 Classical Archaeology
Art History 21/121 Early Islamic Art
Art History 23 Art and Politics of the Middle Ages
Art History 25/125 Medieval Architecture
Art History 28/128 Medieval Art in the Mediterranean
Art History 34/134 Renaissance Venice
Art History 90/190 British Architecture
Art History 92/192 Special Topics [architecture]
Art History 95/195 Boston: Architecture and Urbanism
Art History 103 Aegean Archaeology
Art History 104 Greek Art and Archaeology
Art History 105 Tyrrenhian Archaeology
Art History 106 Roman Art and Archaeology
Art History 120 Armenian Art, Architecture, and Politics
Art History 123 Byzantine Art and Architecture
Art History 126 Monasteries and the Arts
Art History 127 Cathedrals and the Arts
Art History 192 Special Topics (Architecture)
Art History 192A Armenian Architecture and Sculpture
Art History 196 Museum Architecture
Art History 193 Histories of Modern Architecture
Art History 199 Senior Honors Thesis
Civil Engineering 120 The Art of Building
Drama 119 History of Style and Décor

B. STUDIO ART
FAM 20 Design: Foundation
FAM 21 Design: Intermediate to Advanced
FAM 22 Design: Architectural
FAM 23 Design: Advanced Architectural
FAM 26 Drawing: Foundation
FAM 39 Graphic Design
FAM 54 Painting: Foundation
FAM 63 Perspective Drawing
FAM 77 Sculpture: Foundation
FAM 93 Watercolor
Drama 19 Principles of Theatrical Design
Drama 20 Stage Engineering
Drama 21 Computer-Assisted Design
Drama 29 Scene Painting
Drama 93-02 Architectural Styles and Designs
Drama 94-02 Advanced 3-D Design
Drama 125 Scene Design

C. HUMANITIES AND SOCIAL SCIENCES
(Courses with asterisk count toward core requirement.)
*Anthropology 20 Global Cities
Anthropology 42 Extreme Environments
Anthropology 128 Mesoamerican Archaeology
Anthropology 183 Urban Borderlands
*Anthropology 186 Theatres of Community
Economics 30 Environmental Economics
Economics 127 Urban Economics
*English 116 The Country and the City
*History 123 Industrial America and Urban Society
*History 143 South Asian Urban History
*History 161 Vienna
History 193 Cities and Modernity of South Asia
History 290 Material Culture
Philosophy 52 Aesthetics
Philosophy 186 Phenomenology and Existentialism
Political Science 15 Politics and the City
*Political Science 195 Politics of Sustainable Communities
Psychology 27 Perception
Psychology 53 Engineering Psychology
Psychology 130 Advanced Engineering Psychology
*Sociology 113 Urban Sociology
*Sociology 149/UEP 181 Homelessness in America
*Sociology 180 Cities of the Global South
*UEP 101 Land Use Planning
*UEP 105 Urban Planning and Design
*UEP 113 Housing Policy
UEP 173 Transportation Planning
*UEP 178 Urban Policy and Planning
*UEP 181 Homelessness in America
*UEP 200 Land Use Planning
*UEP 264 Green Urban Design
UEP 284 Developing Sustainable Communities
*UEP 233 Regional Planning
*UEP 293-03 Retrofitting Suburbs
*UEP 294-04 Planning and Urban Design

D. ENGINEERING AND TECHNOLOGY
   (Courses with asterisk count toward core requirement.)
Civil and Environmental Engineering 1 Introduction to Civil and Environmental Engineering
Civil and Environmental Engineering 22 Structural Analysis
Civil and Environmental Engineering 24 Steel Design
Civil and Environmental Engineering 25 Reinforced Concrete Design
Civil and Environmental Engineering 53 Engineering Economy
Civil and Environmental Engineering 185 Legal Issues of Engineering
Civil and Environmental Engineering 188 Engineering Design with CAD
*Engineering 01-08 Design of the Built Environment
*Engineering 5 Skyscrapers: Architecture and Engineering
*Engineering 23 Building Big: Infrastructure Engineering
*Engineering 39 Bridge Design
*Engineering 80 Structural Art
*Engineering Psychology 61 Human Factors and Ergonomics
Engineering Psychology 161 Human Factor Product Design
Engineering Science 2 Introduction to Computing in Engineering
SCHOOL OF ENGINEERING

BSE Degree Program in Architectural Studies
A bachelor of science in engineering with a program in architectural studies is available for students interested in a professional career in architecture or in historical, aesthetic, and engineering aspects of buildings and other structures. This program, offered jointly by the department of civil and environmental engineering and the department of art and art history, provides a solid foundation in both the technical aspects of structural systems and the aesthetic and functional characteristics of buildings from an architectural and art history point of view. The flexibility of the BSE degree allows greater concentrations in both art history and studio courses than would otherwise be possible, providing a coherent basis for graduate work in architecture or design. The faculty advisor for this program is Professor Masoud Sanayei.

Degree Requirements
A minimum of 38 courses is required, to be distributed in the following categories:

1. Eleven introductory courses as required for the professional degrees in engineering (see school of engineering information);
2. Engineering science: Engineering Science 5, 9, 88, and an engineering science elective;
3. Civil engineering: Civil and Environmental Engineering 2, 22, 42; plus three from Civil and Environmental Engineering 24, 25, 81, 123, 124, 125, 146, 149, and 188;
4. Architectural Studies: Art History 1, 8, 98, 198; two studio courses, including architectural design (FAM 22) and either FAM 20, 26, or 63; one elective (selected from disciplinary areas A, B, C above);
5. Humanities and social science: five courses;
6. Free electives: five courses

UNDERGRADUATE MINOR PROGRAMS

Architectural Studies
The Department of Art and Art History offers a minor in architectural studies for both liberal arts and engineering students consisting of five courses:

1. Art History 1 Introduction to World Art I
2. Art History 8 Introduction to Architecture, 1400 to the Present
3. Studio Art (FAM 22; or 20, 23, 26; or DR 21)
4. Engineering/Technology course: Engineering 1-08, 5, 23, 39, or 80; or Engineering Psychology 61; or Engineering Science 5, 18, 25, or 27; or GIS 101
5. Upper-level architectural history class (FAH 115, 120, 123, 125, 126, 127, 190, 191, 193, 195, 196, 198, or 192 [architecture]; or CE 120)

Note: Engineering students minoring in architectural studies replace the engineering requirement with an approved course from the major’s disciplinary areas A, B, or C (see above).

Architectural Engineering
The Department of Civil and Environmental Engineering offers a minor in architectural engineering for students in the College of Liberal Arts. The faculty advisor for this minor is Professor Masoud Sanayei.
Art and Art History

Professor Peter Probst, Chair; African art, memory and monuments, historic preservation, cultural property, theories of value, historiography (on leave spring 2017)
Professor Christina Maranci, Acting Chair Spring 2017, Arthur H. Dadian and Ara Oztemel Professor of Armenian Art and Architecture; Byzantine art and architecture
Professor Andrew McClellan, Director of Museum Studies; Baroque-rococo art, museum history and theory
Professor Malcolm Turvey, Sol Gittleman Professor, Director of Film and Media Studies, film history and theory
Associate Professor Cristelle Baskins, Italian Renaissance art, secular painting and narrative, and gender and women’s studies
Associate Professor Ikumi Kaminishi, Director of Undergraduate Studies; Asian art and architecture, Buddhist painting, narrative studies
Associate Professor Karen Overbey, Director of Graduate Studies; Medieval art and architecture, relics and reliquaries, early Irish art
Associate Professor Eric Rosenberg, American art, modern and contemporary art
Associate Professor Adriana Zavala, Modern and contemporary Latin American art, art of Mexico, gender and women’s studies (on leave 2016-17)
Assistant Professor Eva Hoffman, Islamic art and architecture, portable arts
Assistant Professor Jeremy Melius, Modern art and art writing, critical theory and aesthetics, historiography, histories of sexuality
Assistant Professor Jacob Stewart-Halevy, Transfer of Credit Representative, Contemporary art, historiography and theory of conceptual and contemporary art

SECONDARY APPOINTMENTS:
Patrick Carter, Tufts Studio Arts Coordinator and Transfer of Credit Representative for Studio Art Courses on Medford Campus
Amy Ingrid Schlegel, Director, Tufts University Art Gallery; Curatorial studies

Our program aims to provide students with a critical and globally informed understanding of the history of art and visual culture. Understanding the sources, aesthetics, and significance of images that people use to communicate—whether in the confined world of art or beyond—is crucial for anyone wanting to play an active part in society. Students taking art history classes can expect to learn how to look at and write about works of art. Yet they will also learn about the historical and trans-cultural contexts in which visual works emerge and operate. Thus, students taking classes in art history will find themselves immersed in questions of politics, identity, religion, economics, mobility, communication, and many other exciting issues.

As a humanistic discipline, the history of art emphasizes scholarly investigation and critical analysis over technical training. However, majors are encouraged to take studio courses as part of their program and to take advantage of Tufts’ affiliation with the School of the Museum of Fine Arts.

UNDERGRADUATE PROGRAM
The department offers the bachelors of art degrees in art history and in architectural studies.

Art History Concentration
For the bachelor of art degree in art history, ten courses are required for the major: Introduction to World Art I and II and 100; two courses pre-1700; two courses post-1700; and three electives, one of which may be an approved course in a related field (e.g. history, literature, studio art). At least one of the courses in the major must be taken as an upper-level seminar (Art History 198-xx). An art History AP score of 5 exempts majors from Introduction to World Art I and II requirements; two other art history courses are taken in their place.

We believe in the value of exposure to the full breadth of artistic achievement across time and cultures and therefore require all majors to take the two introductory courses, FAH 1 and FAH 2, offered in the fall and spring each year. We strongly recommend that students take these courses early in their course of study, as they allow students to acquaint themselves with different fields and periods and with different faculty. The two surveys are designed as a springboard to the more specialized upper level (two- and three-digit) courses. Students often choose a major advisor based on their experience in the survey. As with all humanistic disciplines, art history is underpinned by certain theories and methods; these are at work in each and every course, but they are also the focus of FAH 100, Theories and Methods of Art History, also a required class for majors, normally taken in the senior year.
Art History Minor
For the minor in art history, 5 courses are required with at least one course taken at the 100 level. Three of the 5 courses should be taken on the Tufts campus, including the 100 level.

FAH 1 Introduction to World Art I, two courses pre-1700, two electives or
FAH 2 Introduction to World Art II, two courses post-1700, and two electives

For inquiries about the art history major or minor, please contact the department at 617-627-3567 or visit the website http://ase.tufts.edu/art/undergraduate/.

Architectural Studies (see also listing above)
The Department of Art and Art History offers an interdisciplinary major and minor in architectural studies for students interested in the study of architecture’s history, theory, and social practice. The major’s core curriculum provides a foundation in art and architectural history and theory, in engineering and design, and in the humanistic and social science aspects of architecture. Architectural studies majors then design their own elective program of upper-level study from designated courses in architectural history, studio art, civil engineering, the humanities, and the social sciences. In spring of the senior year, all majors complete an integrative project, either as individual or honors study, or through an internship.

For the minor in architectural studies, students take five designated courses from the major’s core curriculum, which provide a basic foundation in architecture’s interdisciplinary aspects.

The architectural studies program is designed specifically to provide a broad-based liberal arts education in architecture. It may also help students prepare for graduate study and careers in architecture and other allied disciplines, such as landscape architecture, urban planning, and historic preservation.

For details, see full description under Architectural Studies.

For more information please see the entry for “Architectural Studies” above and also the website http://ase.tufts.edu/art/architecture.

Senior Honors Thesis
Seniors in Art History and Architectural Studies who qualify for the Thesis Honors program (normally restricted to those whose names have appeared on the Dean’s List at least two times before their senior year) may spend their final year writing an honors thesis. Senior theses are demanding but rewarding for both student and faculty. They require a good deal of discipline and focus on the student’s part, but in return they can take you well beyond the classroom and can develop useful research, writing and organizational skills.

In spring semester of junior year, prospective thesis writers, including those studying abroad, should begin consulting with their advisors about possible thesis topics and research plans. By the last Friday of classes of the junior year, all prospective thesis writers, including those studying abroad, must submit to the director of undergraduate studies a single-page prospectus listing the proposed thesis title, department advisor and relevant coursework, plus a short description of the thesis content and research plan. If approved by the department at this preliminary, prospectus stage, the student may then proceed to the proposal stage in close consultation with the advisor. By the first Friday of classes of the senior year, a three- to five-page proposal must be submitted to the director of undergraduate studies listing the thesis title, department advisor, and at least one additional committee member, and also including a lengthier description of the proposed project accompanied by a full research bibliography. The department in mid-September grants or denies approval for the proposed thesis to move forward.

Completed senior theses are due the second to last Friday of April, to be considered for the department’s Madeline Harrison Caviness Thesis Prize. Theses are publicly presented in ten-minute talks at a luncheon held the day after the conclusion of spring classes. Defenses are conducted in late April or early May. After the defense, a final copy of the thesis, in electronic form, must be submitted to the Tisch Library archive and to the department. Seniors’ theses are taken into consideration when awarding academic honors or department prizes.

GRADUATE PROGRAM
The Department of Art and Art History offers the Master of Arts degree in Art History, which has two tracks. The M.A. program normally takes two years to complete.

Entering graduate students choose one of the following tracks:

• M.A. in Art History
• M.A. in Art History and Museum Studies

Applicants for the master of arts degree are expected to have a bachelor’s degree or its equivalent. The undergraduate major in Art History is the best preparation for this program, but not mandatory. Applicants who have undergraduate degrees in other fields but have minored in Art History or have taken three or four undergraduate art history courses are also encouraged to apply.

The following is required for application: a verbal GRE general test score, a recent writing sample, a personal statement, three letters of recommendation, and reading knowledge of one foreign language.

Master of Arts: Art History
The master’s program in art history is designed to provide a broad historical understanding of the visual arts, in addition to developing critical thinking and methodological skills. Students engage these ideas through course work, seminars, independent research, and teaching experience. Students complete their degrees either by writing a thesis or submitting two qualifying papers; either option involves an independent research topic designed by the student in consultation with a faculty advisor. M.A. students from our program are successful in applying to and completing Ph.D. programs.

Requirements for the M.A. degree in Art History:
• Reading knowledge of one foreign language upon entry
• Eight semester courses in art history at the advanced (100 and above) level
• Historiography and Methodology (FAH 101)
• At least three (3) seminars
• Optional one second foreign language course in lieu of a lecture course
• Comprehensive exam
• At least one semester TA or RA (subject to enrollments and funding)
• M.A. thesis or two qualifying papers (QPs).

For inquiries about the program, please contact the director of the graduate program, Associate Professor Karen Overbey, at karen.overbey@tufts.edu or 617-627-2597.

Master of Arts: Art History and Museum Studies
The master’s program in Art History and Museum Studies is designed to give students advance qualification in art history and a broad introduction to museum work. The program is offered for those hoping to work in art collection-related fields. It provides students with skills to integrate theoretical study of art history with practical concerns of displaying, managing, and interpreting art objects in a variety of museum studies simultaneously. Graduates of this program typically pursue careers in museums, art galleries, art publishing, museum education, teaching, art libraries, visual resource collections, or auction houses.

Requirements for the M.A. degree in Art History and Museum Studies:
• Reading knowledge of one foreign language upon entry
• Six semester courses in art history at the advanced (100 and above) level
• Historiography and Methodology (FAH 101)
• At least two (2) seminars
• Five courses in Museum Studies, including a museum internship
• Comprehensive exam
• At least one semester TA or RA (subject to enrollments and funding)
• M.A. thesis, or two QPs, or one QP and an additional Art History seminar

For inquiries about the program, please contact the advisor to the M.A. in Art History and Museum Studies, Professor Andrew McClellan, andrew.mcclellan@tufts.edu.

Policy on Summer Courses (for both tracks)
Courses taken through Tufts Summer Session with the intention of fulfilling a degree requirement must be approved by the student’s department. Provided that the course is required for the degree, the graduate school will pay the summer tuition for full-time students (courses taken in excess of the degree requirements, directed and independent studies, special topics courses, audited courses, and language courses taken to prepare for the language exam are excluded). Students who withdraw from a course or receive a grade below B- will be responsible for paying for the course. All graduate students must pay the $50 registration fee.
STUDIO ART

Studio Art Courses
Through a cooperative agreement between Tufts University and the School of the Museum of Fine Arts, Boston (the Museum School), students may elect courses in studio art for credit at Tufts. Classes are taught both on the Tufts campus, in studios located in Lane Hall and Jackson Gym, and at the Museum School in Boston. More than eighty studio credits are offered to Tufts students.

Studio art courses taught at Tufts University’s Medford campus include drawing, painting, design, calligraphy, photography, sculpture, architecture, and watercolor. These courses can be found in the Tufts online course descriptions by department under “Studio Art—Medford Campus” and are labeled with the FAM course prefix. The Museum School offers expanded course offerings in the above areas, as well as ceramics, sculpture, animation, video, metals, and printmaking. Courses are taught on weekdays, evenings, and Saturdays at the Museum School campus in Boston. These courses can be found in the Tufts online course descriptions by department under “Studio Art—Museum School” and are labeled with the FAMB course prefix (credit value conversion: 2.00 SMFA credits = 0.5 Tufts credits; 4.00 SMFA credits = 1.0 Tufts credits).

Students must register for FAM or FAMB studio courses through the Tufts student registration system. Students who have questions about studio courses or transfer of credit, or need help in planning a comprehensive program of study, should contact Patrick Carter (patrick.carter@tufts.edu), Studio Coordinator at Tufts, Department of Art and Art History, 11 Talbot Avenue.

Studio Art Degree Programs
Combined B.A. or B.Sc. and B.F.A.

BFA Program at the School of Museum of Fine Arts
The SMFA/Tufts BFA program combines an in-depth, rigorous liberal arts education at Tufts University with intensive studio arts training at SMFA. Students are considered to be fully enrolled at both schools, and graduate with a BFA degree from Tufts University.

Students wishing to pursue a studio art degree should only apply to the Museum School, indicating an interest in the Bachelor of Fine Arts. More information on this program may be obtained at the School of Museum of Fine Arts, 230 The Fenway, Boston, Massachusetts 02115, (800) 643-6078 or (617) 369-3626.

BA/BFA Combined Degree Program with the School of the Museum of Fine Arts
The Five-Year Combined Degree program between Tufts and the School of the Museum of Fine Arts is designed for students who wish to pursue their artistic and academic interests to the fullest extent. Students in this program share their time between the Tufts School of Arts and Sciences and the SMFA.

It is a demanding program created for students who wish to develop their abilities in the fine arts to a professional level and also refine and focus their studies in the academic field.

This five-year program may be entered in the freshman or sophomore year. Students have to meet the normal admission standards of the School of the Museum of Fine Arts, and Tufts University for both degrees.

Upon completion of this program, students will graduate with two degrees from Tufts: a Bachelor of Arts or Bachelor of Science in a major of their choice and a Bachelor of Fine Arts.

Master of Fine Arts with Tufts University (MFA)
Recently ranked one of the top 10 most influential Master of Fine Arts programs in the world, the SMFA/Tufts Master of Fine Arts (MFA) is both rigorous and highly selective as it prepares you for a career as a professional artist. Artistic innovation and creativity are fundamental qualities that are highly transferable to wider areas of society. The curriculum integrates practical and critical skills across diverse media and disciplines; you'll hone your practice through individual innovation, creative collaborations, informal mentorships and academic discourse. MFA students are enrolled at both SMFA and Tufts University, and graduate in two years with an MFA degree from Tufts.
Asian American Studies

Director:
Professor Natalie Masuoka, Political Science

Affiliated Faculty:
For an updated list, please see http://as.tufts.edu/asianamericanstudies/faculty

Asian American Studies is an interdisciplinary field dedicated to an examination of the diasporic East Asian, Southeast Asian, South Asian, and Pacific Islander populations. It applies the methods and perspectives of traditional academic disciplines, such as history, sociology, political science, education, psychology and literature, to understanding the histories, communities, and cultures of Asian Americans. The Asian American community today is a diverse one that is comprised of people of different ethnicities, religions, class backgrounds and immigration histories. Scholars of Asian American Studies seek to foster greater public awareness of this diversity and the many social, legal and political contributions Asian Americans have made in society. At the same time, Asian American Studies research challenges students to confront issues of inequality, power and exclusion. Although the original focus has been on the United States, given our increasingly global society and the growing transnational nature of Asian American communities, Asian American Studies has sought to think about the connections that can be made across Asian diaspora around the globe.

The Tufts Asian American Studies program is part of the Consortium on Studies of Race, Colonialism and Diaspora. The Asian American Studies Minor provides a program of study so that students can examine the histories and experiences of Asian Americans alongside their degree pursuits. The program offers courses that introduce students to Asian American Studies and also offers the opportunity for students to craft their own areas of expertise by taking coursework on concepts and issues that intersect with the Asian American experience such as immigration, health care, gender and educational access.

The AAST minor requires six credits and must fulfill the following requirements:

1. One introductory survey/foundation course on Asian American experiences with at least a third of its content on Asian American history
2. At least one course focused on race in which Asian American experiences are addressed in a sociopolitical context.
3. At least one course with full or partial focus on Asian American experiences beyond the foundation
4. Up to two elective courses that while they may not have direct Asian American content, must address topics relevant to the historical and/or contemporary experiences of Asian Americans. Examples include: immigration, educational access, bilingualism, health disparities, labor relations, environmental justice, media representations, cultural resistance productions, comparative race and ethnic studies.
5. Capstone Project or Course.

For more detailed information about the minor, please visit http://as.tufts.edu/asianamericanstudies/
The science of astronomy concerns the general picture of the universe in its broadest sense, from atoms to assemblages of galaxies. Courses in astronomy fall under the Department of Physics and Astronomy, which also offers concentrations in astrophysics at both the undergraduate and graduate levels.

UNDERGRADUATE CONCENTRATION REQUIREMENTS

Minimum Grade Policy
The undergraduate concentration requires a minimum GPA of 2.0 in the courses applied to a major, and no more than one course with a grade less than C-. This policy applies to all majors offered by the department for students entering September 2013 or later.

Major in Astrophysics
The major in Astrophysics requires four courses in astronomy more advanced than Astronomy 10; two courses in mathematics more advanced than Mathematics 42 or 44; and four courses in physics more advanced than Physics 2 or 12, including Physics 13 and 64 or equivalent laboratory experience. One mathematics course and either one physics course or one astronomy course may be replaced by an approved advanced course in a related field. Research experience is strongly recommended.

UNDERGRADUATE MINOR PROGRAM

Minimum Grade Policy
The program requires the completion of five courses, with a minimum grade of C-. Prematriculation credits may not be applied towards the requirements for the minor. The minimum grade policy applies to students entering September 2013 or later.

Minor in Astrophysics
The minor in Astrophysics requires five courses, at least three of which must be courses in astronomy numbered 15 or higher. The remaining courses may be selected from among Physics 11, 12 (or 1, 2), 13, and courses in physics or astronomy numbered 15 or higher.

GRADUATE PROGRAM

Advanced degrees (master’s and doctoral) are offered through the Department of Physics and Astronomy in observational astrophysics. Details are given under Physics and Astronomy. Additional advanced courses may be taken through a cooperative program with Boston University.

For more detailed information, please visit the website http://ase.tufts.edu/physics.
Astrophysics

(FOR DEGREE REQUIREMENTS, SEE ASTRONOMY OR PHYSICS and astronomy.)
Biochemistry

(FOR DEGREE REQUIREMENTS, SEE BIOLOGY OR CHEMISTRY.)
Bioengineering

Professor Mark Cronin-Golomb, Biomedical Engineering; Optical instrumentation, laser tweezers, atomic force microscopy, nonlinear optics

Professor Sergio Fantini, Biomedical Engineering; Biomedical optics, near-infrared spectroscopy, diffuse optical imaging

Professor David L. Kaplan, Biomedical Engineering/Chemical and Biological Engineering; Biopolymer engineering, biomaterials, tissue engineering, regenerative medicine

Professor Krishna Kumar, Chemistry; Novel methods for rational design and construction of artificial proteins, molecular enzymes, and self-assembling biomaterials

Professor Barry A. Trimmer, Biology; Central processing of sensory information by receptors, second messengers and synaptic networks in insect model system, neural control of soft-bodied locomotion

Professor David R. Walt, Robinson Professorship in Chemistry; Surface, polymer and materials chemistry, fluorescence resonance energy transfer, immunosensors, corrosion sensing, neurotransmitter sensing, micro- and non-sensors, cell-based biosensors, and sensors based on principles of the olfactory system

Associate Professor Caroline G. L. Cao, Mechanical Engineering; Endoscopy and surgery, human factors, remote instrumentation, human-machine interface

Associate Professor Irene Georgakoudi, Biomedical Engineering; biomedical imaging

Associate Professor Kyongbum Lee, Chemical and Biological Engineering; Biochemical and biomedical engineering, metabolic engineering, tissue engineering, bioinformatics, and systems biology

Research Associate Professor Aurelie Edwards, Chemical and Biological Engineering; Biological transport phenomena involving fluid and solute transport in living tissues (kidney and eye) to address organ function, disease origin, and drug delivery

Research Assistant Professor Greg Altman, Biomedical Engineering; Collagen-based matrices, ligament formation, impact of mechanical forces on human adult stem cell differentiation, bioreactor system, in vitro tissue formation and development

Bioengineering is the integration of physical, chemical, or mathematical sciences and engineering principles for the study of biology, medicine, behavior, or health. The bioengineering programs provide comprehensive education and research at the School of Engineering and the School of Arts and Sciences in collaboration with Tufts’ medical, dental, veterinary, and nutrition schools.

A number of part- and full-time degree programs and certificates are offered in the fields of biomedical engineering, biotechnology, and drug discovery and assessment. Biomedical engineering involves the application of state-of-the-art technology to device design and fabrication; biotechnology includes protein expression, folding and assembly, biomaterials and tissue engineering, and biofilms as examples; drug discovery and assessment includes disease markers, resistance mechanisms, and new drug discovery.

For information on programs in bioengineering, please contact the bioengineering center office at 617-627-2580.

UNDERGRADUATE PROGRAMS

Biomedical Engineering
(SEE BIOMEDICAL ENGINEERING FOR A DESCRIPTION OF THE PROGRAMS.)

Biotechnology
(SEE BIOTECHNOLOGY FOR A DESCRIPTION OF THE PROGRAMS.)

GRADUATE PROGRAMS

Graduate degree programs are tailored to the background and goals of the individual student. Degree programs may be pursued on a part-time or full-time basis. Master’s programs may be either course-based or thesis research-based.

Doctoral programs may be pursued part-time, with a one-year residency requirement.

Bioengineering Faculty advisor:
Associate Professor Kyongbum Lee, Chemical and Biological Engineering

The School of Engineering offers a master’s degree program in Bioengineering. This interdisciplinary pro-
gram provides a broad engineering and biotechnology curriculum, while offering a focus on a specific engineering track that best fits students’ interests and career choices. This combination gives our bioengineering graduates professional flexibility, a distinct competitive advantage in the ever-changing field of bioengineering.

The Bioengineering master’s program has six tracks:

- Bioinformatics
- Biomaterials
- Biomechanical Systems and Devices
- Cell and Bioprocess Engineering
- Environmental Biotechnology
- Signals and Systems

For more detailed information, including descriptions of the core curriculum and the individual tracks, please visit the website [http://engineering.tufts.edu/bioengineering](http://engineering.tufts.edu/bioengineering).

**Biomedical Engineering**

(SEE BIOMEDICAL ENGINEERING FOR A DESCRIPTION OF THE PROGRAMS.)

**Biotechnology**

(SEE BIOTECHNOLOGY FOR A DESCRIPTION OF THE PROGRAMS.)

**CERTIFICATE PROGRAMS**

Four-course graduate-level certificate programs are designed for science, engineering, and medical professionals seeking graduate-level programs to expand their knowledge of biomedical science, biotechnology, and engineering. The certificates are offered in conjunction with the departments of biology, chemistry, chemical and biological engineering, and biomedical engineering. The certificate programs can be completed on a part-time, non degree basis by students who are seeking professional training in the field or preparing for a degree program. In most cases, courses taken as a certificate student can be transferred into a related master’s degree program. The programs are open to students who have already earned a bachelor’s degree.

**Bioengineering**

The certificate program in bioengineering consists of an interdisciplinary course of study that allows students to focus on areas such as biomedical instrumentation, biomedical optics, biomaterials/biotechnology and tissue engineering. Courses are taught by faculty in engineering as well as experienced clinical professionals from Tufts’ health science schools.

The certificate requires four courses.

One bioengineering introductory course:
- **Biomedical Engineering 250** Introduction to Biomedical Engineering I (focus on biomedical engineering and instrumentation) or
- **Biomedical Engineering 162** Molecular Biotechnology (focus on molecular biology and engineering aspects of biotechnology)

One physiology course (choose five modules):
- **Biomedical Engineering 121/122** Engineering Challenges in Physiology I and II (modules include general, neurology/nose, skeletal/bone, respiratory, cardiovascular, renal, gastrointestinal, endocrine, eye, dental)

One engineering elective in biomedical instrumentation, biomedical optics, biomaterials, biotechnology, or tissue engineering

One capstone course:
- **Biomedical Engineering 100** Design of Medical Instrumentation or
- **Biomedical Engineering 164** Biomaterials and Tissue Engineering

For more detailed information, please visit the website [http://engineering.tufts.edu/bme/](http://engineering.tufts.edu/bme/).
Bioengineering Certificate Program

Faculty advisors:
Professor Mark Cronin-Golomb, Biomedical Engineering
Professor David L. Kaplan, Biomedical Engineering / Chemical and Biological Engineering

The booming biomedical industry demands skilled professionals whose expertise can cross traditional boundaries of science and engineering. Companies are seeking electrical engineers who understand the medical uses of diagnostic imaging instrumentation, biotechnology professionals with training in tissue engineering to develop tissue implants, and mechanical engineers who are well-versed in biomaterials to design artificial joints.

The certificate in Bioengineering addresses this need through a highly interdisciplinary course of study that allows students to focus on biomedical instrumentation, biomedical optics, biomaterials/ biotechnology and tissue engineering or other related areas of study. Courses are taught by faculty in engineering as well as experienced clinical professionals from Tufts’ world-renowned health science schools.

The program is open to students with at least a bachelor’s degree in engineering, science, or health science.

With this certificate engineers can launch careers in biomedical instrumentation design. Clinical practitioners and technicians can shift careers to biomedical equipment sales. It is also a useful technology complement for executives, medical professionals, and policy makers interested in the application of technology to the medical, business or legal profession.

The certificate requires the completion of four courses.

For more information, contact the program administrator, Angela Foss, at 617-627-2320 or visit the website http://gradstudy.tufts.edu/programs/certificates/index.htm.
Biology

Professor Sergei Mirkin, Department Chair, White Family Chair in Biology; Molecular genetics
Professor Frances Sze-Ling Chew, Vice Chair; Ecology, plant-insect interactions
Professor Susan G. Ernst, Developmental biology
Professor Catherine Freudenreich, Molecular biology and genetics
Professor Michael Levin, Vannevar Bush Professor and Director of Tufts Center for Regenerative and Developmental Biology; Morphological and behavioral information processing living systems
Professor Sara M. Lewis, Evolutionary and behavioral ecology
Professor Colin M. Orians, Ecology, plant-herbivore-environment interactions
Professor Jan A. Pechenik, Invertebrate zoology, marine invertebrate reproduction
Professor J. Michael Reed, Conservation biology, ornithology, behavior
Professor L. Michael Romero, Physiological endocrinology, physiology of stress
Professor Barry A. Trimmer, Henry Bromfield Pearson Professor of Natural Sciences; Neurotransmitters and receptors in insects, intracellular signals
Associate Professor Harry A. Bernheim, Organismal physiology, immunology
Associate Professor Elizabeth Crone, Population ecology, theoretical ecology, plant-animal interactions
Associate Professor George S. Elmore, Draupner Ring Scholar; Plant development, experimental plant morphology, anatomy
Associate Professor Juliet Fuhrman, Immunology and parasitic diseases
Associate Professor Kelly A. McLaughlin, Cell biology, cell signaling of organogenesis
Associate Professor Mitch McVey, Molecular biology, genomic instability
Associate Professor Philip T. B. Starks, Evolutionary dynamics of parasite and host populations
Assistant Professor Erik B. Dopman, Evolution and genetics of natural populations
Assistant Professor Stephen M. Fuchs, Biochemistry and molecular biology, interplay between protein structure and protein function
Assistant Professor Julia Svoboda Gouvea, Education; Biology education
Assistant Professor Eric D. Tytell, Biomechanics and neural control of locomotion
Assistant Professor Benjamin Wolfe, Microbiology, ecology and evolution of microbial communities
Senior Lecturer Susan Koegel, Cell biology and immunology
Lecturer Michelle Gaudette, Molecular biology, gene regulation of development
Lecturer Ekaterina “Kate” Mirkin, Genetics
Research Associate Professor Dany S. Adams, Role of ion flux during morphogenesis of vertebrate embryos

SECONDARY APPOINTMENTS:
Adjunct Professor David L. Kaplan, Biomedical Engineering; Biotechnology, biomaterials
Adjunct Associate Professor Mark Pokras, Cummings School of Veterinary Medicine at Tufts University, Department of Environmental and Population Health; Wildlife medicine

Biology is the scientific study of living organisms. Derived from the search for organized understanding of plants and animals in their natural environments, contemporary biology is increasingly successful in characterizing the basic molecular processes that are essential to all forms of life. Modern experimental studies on the origin, evolution, and physiological mechanisms of life are of profound philosophical importance and provide the underlying foundation for research in biology and for the teaching of biology. They also provide the basic knowledge used in applied fields such as medicine, biotechnology, and environmental biology.

Biology students should aspire to understand the central principles governing life processes at both molecular and higher levels. An increased comprehension of the problem-solving methods of science, as used within the laboratory and in the analysis of contemporary environmental and biosocial problems, should be a concomitant goal. Biology majors, especially those preparing for graduate work, are expected to learn how to critically evaluate original research literature. This can be done by enrolling in seminar courses that are designed to investigate topics by utilizing the primary literature. Small class sizes in seminars allow students to present papers and participate in class discussions.

Laboratories are available for study and research in selected areas of biochemistry, neurobiology, immunology, endocrinology, molecular biology, cell biology, genetics, physiology, plant sciences, behavior, and ecology. Controlled-environment rooms, marine and freshwater aquaria, and a greenhouse are among the diversified resources for the experimental work. Fieldwork experience at marine laboratories or other biological stations is encouraged.
UNDERGRADUATE CONCENTRATION REQUIREMENTS

**Major in Biology**
Ten courses, including eight courses in biology numbered 13 or higher (with the exception of Biology 16, 91, 93, and 94), at least six of which must be completed with a grade of C- or better, and either two courses in chemistry (chosen from Chem 1, 2, 11, 12, 51, 52) or two courses in physics (chosen from Physics 1, 2, 11, 12). At least four of the eight biology courses must be taken at Tufts. It is recommended that students take at least one seminar course. The eight biology courses must include Bio 13, 14 and 41 and at least one course in each of the biology of cells (Group A), biology of organisms (Group B), and biology of populations (Group C). The particular group in which a course is categorized for this purpose is indicated at the end of the course description. Absence of such designation indicates that the course cannot be used to fulfill any group of the distribution requirements, although the credits are applicable toward the total required for a major.

At least two courses in biology must include a laboratory study, and one of these must be above the level of Biology 14. In fulfilling this laboratory requirement, students may choose from among those biology courses for which laboratory is specified in the course description, with the following exceptions: Biology 93, 94, and 187.

Biology 193 or 194 may be used as only one of the eight biology courses for completion of the concentration requirements; on approval of a petition to the department, a maximum of two such courses may be applied toward the major. In no case may more than one of these courses be used to fulfill the laboratory requirement.

The foregoing is a minimal program. For many purposes, additional preparation in related sciences and calculus is needed. A course in calculus and laboratory courses in both organic chemistry and physics are strongly advised. A course in statistics should be included when advanced work in ecology, evolution, or genetics is anticipated. Medical schools require a year of general chemistry, a semester of organic chemistry, a year of physics, and a year of biology, all with laboratory. A semester of biochemistry is required. Calculus and psychology are recommended. Students planning to enter graduate school or seeking employment in biological research should take more than the minimal number of laboratory courses required for the biology major.

To be eligible for a summa cum laude degree, a student must have done biology research equivalent to Biology 93. Comparable research in related fields will also be considered. Participation in the Thesis Honors Program will entail writing and defending a thesis based on laboratory or field research.

**Major in Biochemistry**
The Biochemistry major requires Chemistry 1, 11, or 16 and Chemistry 2 or 12; Chemistry 51/53, 52/54, 31, 42, 171, and 172; Biology 13, 41, 50 (or Chemical and Biological Engineering 163), and 105. Course work in mathematics (Mathematics 34) and physics (Physics 2 or 12) is required as a prerequisite to Chemistry 31. The following sequence of courses is suggested for students concentrating in biochemistry: first year, Chemistry 1 (or 11) and 2 (or 12), Biology 13, Mathematics 32; second year, Chemistry 51/53, 52/54, and 171, Mathematics 34, Physics 1 and 2 (or 11 and 12); third year, Chemistry 172, Biology 41, 105, and 50 (or Chemical and Biological Engineering 163); fourth year, Chemistry 31 and 42.

**Major in Biopsychology**
Biopsychology is an interdepartmental major for students particularly interested in neurobiology and behavior. There are ten required courses: five in biology and five in psychology. These include the following: Cells and Organisms (Biology 13), General Genetics (Biology 41), Animal Behavior (Biology 130), one course in animal physiology (chosen from among Biology 75, 110, 115, 117, 134), and an elective in biology; Statistics (Psychology 31 or Biology 132), Experimental Psychology (Psychology 32), Brain and Behavior (Psychology 103), plus two electives from among Psychology 22, 26, 27, 29, 40, 41, 42, 46, 48, 49, 104, 112, 117, 123, 127, 128, 129, 142, 146, 154, and 159. Biopsychology majors may not double major in psychology or biology. Majors are encouraged to elect an advanced laboratory course in either department. Consult the departments of either biology or psychology for details about this program.

**Course Selection for Undergraduates**
For students with an interest in biology or the health sciences and a strong high-school science background, Biology 13 is the most appropriate beginning course, and may be taken concurrently with Chemistry 1 or 11. Biology 13 and 14 are normally prerequisites for more advanced work in biology.

Students interested in biology but not planning to major in the sciences might take Biology 1, 2, 6, 7, 8, 10 or 12. None of these may be counted among the eight courses in biology used to satisfy the concentration requirements.
requirements.

GRADUATE PROGRAM
Before beginning advanced study in a specialty, all graduate students in biology are expected to have the broad course work and laboratory experience that is equivalent to the requirements for an undergraduate major in this department. The student’s entrance committee will determine what courses, if any, should be taken in the first year to fulfill these requirements. Graduate instruction and research opportunities are offered in six areas: 1) ecology, behavior, and evolution; 2) global change biology; 3) genetics and molecular biology; 4) developmental biology; 5) physiology, neurobiology and biomechanics.

More information is available at http://ase.tufts.edu/biology.

Master of Science
A candidate for the master’s degree in biology must complete at least eight different graduate-level courses, of which at least four must be in the Department of Biology. All courses must be approved by the committee appointed to guide the student’s work. Courses taken at recognized marine laboratories or field stations may be offered for credit. No more than two credits may be transferred from another institution.

Research Master of Science Degree: A research master of science student must take six courses for letter grades (B- or better) including one required seminar (normally either Biology 243, Topics in Molecular and Cell Biology, or Biology 244, Topics in Evolutionary Ecology). No more than one of these six may be guided individual study (Biology 293 or 294). Also required for the research master of science are two research courses (Biology 295 and 296) and preparation and successful defense of an original thesis. A student in a research master’s program is normally expected to serve as a teaching assistant for at least one semester.

Course-work Master of Science Degree: A course-work master of science student must take eight courses for letter grades (B- or better) including one required seminar (normally either Biology 243, Topics in Molecular and Cell Biology, or Biology 244, Topics in Evolutionary Ecology).

Students in the B.S.-M.S. combined-degrees program are normally required to prepare an original thesis.

Doctor of Philosophy
A candidate for the Doctor of Philosophy degree is expected to plan and undertake a program of advanced study and research in consultation with a faculty committee. The candidate is required to serve as a teaching assistant for at least two semesters.

During the first year, students are expected to complete at least two research rotations (Bio 253/254). Following completion, students must choose and be accepted into the laboratory of a faculty member under whose direction they will carry out their research and prepare their dissertations.

Entry into the Ph.D. degree program is not official until the candidate passes a qualifying procedure. The procedure includes a written examination in the candidate’s field of special interest and related areas, and the preparation and defense of a detailed written thesis research proposal.

For more detailed information, please visit the website http://ase.tufts.edu/biology.
Biomedical Engineering

**Professor David Kaplan**, Chair and Stern Family Professor; Biopolymer engineering, biomaterials, tissue engineering, regenerative medicine

**Professor Mark Cronin-Golomb**, Optical instrumentation, laser tweezers, atomic force microscopy, nonlinear optics

**Professor Sergio Fantini**, Biomedical optics, near-infrared spectroscopy, diffuse optical imaging

**Professor Fiorenzo Omenetto**, Frank C. Doble Professor; Ultrafast nonlinear optics, medical optics

**Associate Professor Lauren Black**, Cardiovascular tissue engineering, tissue mechanics and visualization, computational modeling, myocardial infarction, regenerative medicine, cardiogenesis

**Associate Professor Irene Georgakoudi**, Biomedical spectroscopic imaging and characterization, in vivo flow cytometry, biomedical instrumentation

**Associate Professor Qiaobing Xu**, Biomaterials, drug delivery, micro/nanofabrication, tissue engineering

**Associate Professor Xiaocheng Jiang**, Nanobiotechnology, microfluidic biotechnology, bioelectronics, biomaterials

**Associate Professor Brian Timko**, Drug delivery, tissue engineering, and nanoelectronics

**Research Professor Barbara Brodsky**, Collagen folding and degradation

**Research Professor Zoia Monaco**, Chromosome biology, genome stability, gene expression, human artificial chromosome

**Research Associate Professor Alessandra Balduini**, Regulation, environment and pathology of megakaryocytes to platelets

**Research Assistant Professor Daniela Moralli**, Chromosome biology, cytogenetics, human artificial chromosome

**Research Assistant Professor Angelo Sassaroli**, Near-infrared spectroscopy, functional brain imaging

**Professor of the Practice Janet Krevolin**, Biomedical engineering, product development, medical devices, design of experiments

**Professor of the Practice Jean-Michel Molenaar**, Digital fabrication, rapid prototyping, additive fabrication, (nano-)/(bio-)fab

SECONDARY APPOINTMENTS:

**Adjunct Professor Peter Bergethon**, Pfizer Inc./Boston University School of Medicine; Computational neurology

**Adjunct Professor John Castellot**, Tufts University School of Medicine; Cellular and molecular biology, vascular systems

**Adjunct Professor Jonathan Garlick**, Tufts University School of Dental Medicine; Tissue models to study human disease processes in stratified squamous epithelium

**Adjunct Professor Jim Harden**, University of Ottawa; Biomolecular assemblies, biomaterials, computational biophysics, cell mechanics, complex fluids

**Adjunct Professor Krishna Kumar**, Department of Chemistry; Novel methods for the rational design and construction of artificial proteins, molecular enzymes, and self-assembling biomaterials

**Adjunct Professor Lorenz Meinel**, University of Wuerzburg; Drug delivery interfaces

**Adjunct Professor Michael Levin**, Department of Biology; Regenerative and developmental biology

**Adjunct Professor Eric Miller**, Department of Electrical and Computer Engineering; Signal and image processing algorithms

**Adjunct Professor John Richmond**, New England Baptist Hospital, Tufts Medical Center; Ligament formation, treatment of injuries of the anterior cruciate ligament, regulation and proliferation of growth factor expression in arthrofibrosis

**Adjunct Professor Igor Sokolov**, Department of Mechanical Engineering; Condensed matter, soft condensed matter and biomedical research, energy-related materials and sustainability, surface science and engineering

**Adjunct Professor Barry Trimmer**, Department of Biology; Central processing of sensory information by receptors, second messengers and synaptic networks in an insect model system, neural control of soft-bodied locomotion

**Adjunct Professor Gordana Vunjack-Novakovic**, Columbia University; Transport phenomena, tissue engineering and bioreactors

**Adjunct Professor David Walt**, Department of Chemistry; Bioanalytical chemistry, materials chemistry, biochemistry, and nanoscience

**Adjunct Professor Pam Yelick**, Tufts University School of Dental Medicine; Molecular genetic analyses of craniofacial cartilage, bone, and tooth development

**Adjunct Associate Professor Luis Dorfmann**, Department of Civil and Environmental Engineering; Mechanical properties and behaviors of materials, couple field phenomena, fracture, cavitation and failure processes, characterization and modeling of soft materials

**Adjunct Associate Professor Blaise Frederick**, McLean Hospital; Magnetic resonance equipment and techniques for the study of psychiatric illness in Alzheimer’s disease and substance abuse
Adjunct Associate Professor Carl Kirker-Head, Cummings School of Veterinary Medicine at Tufts University; Bone growth and remodeling, bone repair in response to injury, bone grafting, surgical and other orthopaedic disease models, musculoskeletal vascular disease, bone and soft tissue biomechanics, skeletal tissue engineering, orthopaedic device development

Adjunct Associate Professor Thomas Schnelldorfer, Tufts University School of Medicine; Cancer metastases

Adjunct Associate Professor Sameer Sonkusale, Department of Electrical and Computer Engineering; Mixed-signal VLSI design, sensor electronics

Adjunct Assistant Professor Bree Aldridge, Tufts University School of Medicine; Identifying determinants of mycobacterial tolerance to antibiotic stress in cases of tuberculosis

Adjunct Assistant Professor Niall Lennon, Broad Institute of MIT & Harvard; Molecular biology, cell biology, nanobiotechnology, genomics

The biomedical engineer is responsible for design and development of the technology and devices that are at the heart of the far-reaching improvements in human health that have been occurring over the last few decades. These advances include better tools for understanding disease and health, as well as better ways to both treat disease and maintain health. The rapid expansion of the field of biomedical engineering is due to many factors, including 1) scientific and technological advances in the life sciences, materials science, and the engineering disciplines; 2) the increasing recognition of the role of interdisciplinary strategies to solve complex biomedical problems; and 3) the aging of the population, leading to increasing healthcare needs and the associated demands and costs. The vision of the Biomedical Engineering Department is to promote integrative research, education, and entrepreneurship at the forefront of biomedical science and engineering. The mission of the Biomedical Engineering Department is to advance the field of biomedical engineering through an interdisciplinary approach to education, design, and research.

UNDERGRADUATE PROGRAMS

Bachelor of Science in Biomedical Engineering

The bachelor of science in biomedical engineering (B.S.B.M.E.) is a degree program that combines training in design, research, and practical methods, with a solid math, science, and engineering curriculum to provide education with breadth and depth in the field. A key aspect of biomedical engineering is its interdisciplinary nature; introductory courses in mathematics, statistics, biology, chemistry, and physics, together with foundation/concentration engineering courses, build the basis for creating the synergy among these disciplines that is required in the practice of biomedical engineering. The mission of the bachelor of science degree in biomedical engineering is to provide students with undergraduate educational experiences that provide a sound basis for professional practice in biomedical engineering, life-long learning, and leadership roles in the biomedical engineering field.

The curriculum leading to the bachelor of science degree in biomedical engineering is intended to prepare students to continue with graduate study either in biomedical engineering or medicine, or to enter professional practice as an engineer or designer of biomedical systems. The curriculum includes intensive instruction in math, sciences and engineering disciplines, design and research projects, and biomedical engineering-specific courses, culminating in a year-long senior capstone project.

The student outcomes of the B.S.B.M.E. specify that, by the time of graduation, all graduates will be able to:

- Apply fundamental knowledge of mathematics, statistics, physical sciences, biology, physiology, and engineering for the solution of problems at the interface of engineering and biology;
- Make measurements on and interpret data from living systems, addressing the problems associated with the interaction between living and non-living materials and systems;
- Communicate effectively, work as part of a multidisciplinary team, and have an awareness of professional and ethical responsibilities to have a positive impact on society;
- Recognize the importance of life-long learning in order to expand one’s knowledge base;
- Participate in creative and integrative design projects and independent research projects.

On the basis of the program educational objectives of the B.S.B.M.E., graduates of the program will:

- Be successful in tackling open-ended biomedical engineering problems in a quantitative and systematic fashion;
- Be motivated to continuously expand their knowledge and be creative and innovative in their contributions to the field of biomedical engineering;
- Perform, manage, or lead original engineering design and research projects in an ethical and professional manner; carry this out at the highest levels in private industry, research laboratories, medical
school, or graduate and professional schools.

The program leading to this degree is accredited by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET).

A sample course schedule for the B.S.B.M.E. program (38 credits) is listed below. Of the thirty-eight course credits required for the professional degrees accredited by the Engineering Accreditation Commission of ABET, a minimum of 9.5 course credits must be completed in college-level math and basic science subjects appropriate to the discipline, and a minimum of 14.5 course credits must be completed in engineering topics, consistent with ABET general and program criteria.

**First Year**
**FALL TERM**
Mathematics 32
Physics 11 (+ lab)
English 1
Introductory Engineering 1

**SPRING TERM**
Mathematics 36
Physics 12 or Chemistry 1 (+ lab)
Engineering Science 2
Humanities or social sciences or arts elective

**Sophomore Year**
**FALL TERM**
Mathematics 42
Biology 13
Chemistry 1 or Chemistry 2 or Physics 12 (+ lab)
Engineering Science 5
Biomedical Engineering 50
Biomedical Engineering 3 (half credit)

**SPRING TERM**
Mathematics 51
Chemistry 2 or Physics 12 (+ lab)
Engineering Science 7
Humanities or social sciences or arts elective
Biomedical Engineering 4 (half credit) or Biomedical Engineering elective

**Junior Year**
**FALL TERM**
Biology 41
Engineering Science 3
Engineering Science 8
Biomedical Engineering 121
Biomedical Engineering 153
Biomedical Engineering 5 (half credit)

**SPRING TERM**
Biomedical Engineering 51
Biomedical Engineering 62
Biomedical Engineering 100
Foundation elective
Humanities or social sciences or arts elective
Biomedical Engineering 6 (half credit) or Biomedical Engineering 194-EDP

**Senior Year**
**FALL TERM**
Probabilities and Statistics elective
Biomedical Engineering 51 or Biomedical Engineering 165
Concentration elective
Humanities or social sciences or arts elective
Biomedical Engineering 7

SPRING TERM
Biomedical Engineering 131 or Biomedical Engineering 154
Concentration elective
Humanities or social sciences or arts elective
Free elective
Biomedical Engineering 8

The selection of elective courses described above may be altered for program flexibility. The assignments here reflect one possible way of meeting the requirements for the degree. A list of appropriate foundation and concentration electives is available from the department.

Second Major in Biomedical Engineering
The second major in biomedical engineering is offered to engineering students. Students must enroll in conjunction with another engineering undergraduate departmental major. For the second major in biomedical engineering, students are required to complete ten courses. No more than five of these courses may be used to fulfill the concentration requirement of the first major. All ten courses must be taken for a letter grade. The ten credits required for the second major in biomedical engineering are as follows:

1. Biology 13 or Engineering Science 11b
2. Physics 12 or Chemistry 2
3. Probability and Statistics elective
4. Engineering Science 3 or Engineering Science 5
5. Engineering elective
6. Biomedical Engineering 50
7. Biomedical Engineering 62 or Biomedical Engineering 100
8. Biomedical Engineering 153 or Biomedical Engineering 131
9. Biomedical Engineering elective
10. Biomedical Engineering elective

Second Major in Biomedical Sciences
The second major in biomedical sciences is offered to liberal arts students. Students must enroll in conjunction with another undergraduate departmental major. For the second major in biomedical sciences, students are required to complete ten courses. No more than five of these courses may be used to fulfill the concentration requirement of the first major. All ten courses must be taken for a letter grade. The ten credits required for the second major in biomedical sciences are as follows:

1. Biomedical Engineering 50
2. Biomedical Engineering 62
3. Three Biomedical Engineering elective courses
4. Five elective courses related to biomedical sciences, including independent studies, research, and design projects, that are approved by the BME Second Major Advisor.

GRADUATE PROGRAMS
The Department of Biomedical Engineering offers programs leading to the degrees of master of science (M.S.) and doctor of philosophy (Ph.D.) for students preparing for careers in which research is a central activity. Students can be accepted into the M.S. program, or directly into the Ph.D. program. An M.Eng. or M.S. degree is not required for students to apply to the Ph.D. program. Students who receive the M.S. degree at Tufts and wish to continue their studies toward the Ph.D. need to be formally accepted into the Ph.D. program.

M.S. students can pursue either a course-based M.S. program or a program which includes a significant research component (M.S. with thesis). The M.S.-thesis and Ph.D. programs in the Department of Biomedical Engineering are strongly research-oriented, with emphasis on independent research work reflected in the candidate’s thesis or dissertation. Because biomedical engineering is a multidisciplinary field, students are expected to work in collaboration with scientists in diverse fields including engineering, health, and life sci-
ences. The required courses consist of foundation courses and elective courses. The purpose of the foundation courses is to provide a broad background in biomedical engineering, and to introduce the research activities in the department. The purpose of the elective courses is to provide in-depth knowledge in specific areas of biomedical engineering as a solid basis for students to excel in their research work. It is advisable that M.S.-thesis and Ph.D. students first identify a field of interest and a research advisor, and then select elective courses around the research topic of choice. At the discretion of the research advisor, students who lack suitable preparation in some areas may be given the opportunity to take or audit additional undergraduate-level courses, and students who are already qualified may be exempt from some courses. Transfer of a limited number of graduate course credits is also possible.

GRE and TOEFL (if applicable) are required for admission into the programs. Prospective students can obtain more admission information, financial aid information and application forms at http://gradstudy.tufts.edu.

**Master of Science**
The department offers a program leading to the master of science (M.S.) degree in biomedical engineering. The M.S. program is aimed at students who desire to acquire broad knowledge in biomedical engineering. The emphasis is on multidisciplinary interfaces in the areas covered by biomedical engineering.

Ten credits are required for the M.S. degree: two foundation courses (2 credits), six graduate courses (6 credits), a project (1 credit) and a professional education course (1 credit).

**Master of Science with thesis**
The department also offers a program leading to the master of science (M.S.) degree in biomedical engineering with a strong emphasis on research.

Ten credits are required for the M.S. with thesis degree: two foundation courses (2 credits); four graduate courses, which can include special topics courses (4 credits); research seminars for at least two semesters (2 half-credits); and a thesis (3 credits).

**Doctor of Philosophy**
The department offers a program leading to the Ph.D. degree in biomedical engineering. Thirty credits are required for a Ph.D. with prior B.S. degree: three foundation courses (3 credits); graduate elective courses, which may be special topics courses (at least 5 credits); research seminars for at least four semesters (4 or more half-credits); a project focused on the thesis proposal preparation and defense (1 credit); and a thesis (up to 19 credits). Twenty credits are required for a Ph.D. with prior M.Eng. or M.S. degree: three foundation courses (3 credits), graduate elective courses (at least 1 credit), research seminars for at least four semesters (2 or more credits), a project focused on the thesis proposal preparation and defense (1 credit), and a thesis (up to 13 credits).

For more detailed information, please visit the website http://engineering.tufts.edu/bme.
Biopsychology

(for degree requirements, see biology or psychology.)
Biotechnology

FACULTY ADVISOR:
Professor David Kaplan, Biomedical Engineering/Chemical and Biological Engineering

Biotechnology has applications in a number of diverse fields, including recent growth in gene therapy, protein and tissue engineering, bioinformatics and bioremediation. The tools of biotechnology are now universally applied both to basic research efforts and to large-scale manufacturing processes, and the field is continuing to grow at a rapid pace.

SECOND MAJOR IN BIOTECHNOLOGY
This program is offered as a major only in conjunction with enrollment in a regular undergraduate major, ordinarily excluding interdisciplinary programs. The biotechnology program has been designed with two tracks: a science track for undergraduate students enrolled in the College of Liberal Arts, and an engineering track for undergraduate students enrolled in the School of Engineering.

Core Curriculum
Engineering Science 11 Engineering and Biology or Biology 13 Cells and Organisms
Biology 41 Genetics
Biomedical Engineering/Chemical and Biological Engineering 62/162 Molecular Biotechnology

One laboratory course from:
Biology 50 Experiments in Biology II
Biomedical Engineering 175 Tissue Engineering Laboratory
Chemical and Biological Engineering 163 Recombinant DNA Techniques
Chemical and Biological Engineering 168 Biotechnology Processing Projects Laboratory

Track Curricula
SCIENCE TRACK
Two core courses:
Biology 105 Molecular Biology
Biology 152 Biochemistry and Cellular Metabolism or Biology/Chemistry 171 Organic Chemistry of Living Systems: Biochemistry

Four electives from:
Biology 103 Developmental Biology
Biology 104 Immunology
Biology 106 Microbiology
Biology 153 Topics in Biochemistry
Biology 177 Topics in Inflammation
Biology 184 Topics in Developmental Biology
Biomedical Engineering/Biology/Chemical and Biological Engineering 162 Molecular Biotechnology
Biomedical Engineering 165 Drug Delivery
Chemical and Biological Engineering 160 Biochemical Engineering
Chemical and Biological Engineering 161 Protein Purification
Biomedical Engineering/Chemical and Biological Engineering 153 Biomaterials and Regenerative Medicine
Biomedical Engineering/Chemical and Biological Engineering 154 Tissue Engineering and Regenerative Medicine
Chemical and Biological Engineering 166 Principles of Cell and Microbe Cultivation
Chemical and Biological Engineering 167 Metabolic and Cellular Engineering
Chemistry 135 Biophysical Chemistry

Up to two credits of research may be counted toward electives.

ENGINEERING TRACK
Two core courses:
Four electives from:

- Biology 103 Developmental Biology
- Biology 104 Immunology
- Biology 105 Molecular Biology
- Biology 106 Microbiology
- Biology 152 Biochemistry and Cellular Metabolism
- Biology 153 Topics in Biochemistry
- Biology 177 Topics in Inflammation
- Biology 184 Topics in Developmental Biology

- Biomedical Engineering 165 Drug Delivery
- Chemical and Biological Engineering 160 Biochemical Engineering
- Chemical and Biological Engineering 62/162 Molecular Biotechnology
- Biomedical Engineering/Chemical and Biological Engineering 153 Biomaterials and Regenerative Medicine
- Biomedical Engineering/Chemical and Biological Engineering 154 Tissue Engineering and Regenerative Medicine

- Chemical and Biological Engineering 167 Metabolic and Cellular Engineering
- Chemistry 135 Biophysical Chemistry
- Chemistry 171 Organic Chemistry of Living Systems: Biochemistry

Two credits of research may be counted toward electives.

MINOR IN BIOTECHNOLOGY ENGINEERING

The minor in biotechnology engineering is offered to students in the School of Engineering and the College of Liberal Arts. Five courses are required for this minor.

One course from the following:

- Biology 152 Biochemistry and Cellular Metabolism or Biology/Chemistry 171 Biochemistry

Two courses from the following:

- Chemical and Biological Engineering 161 Biochemical Separation
- Biomedical Engineering/Chemical and Biological Engineering/Biology 62/162 Molecular Biotechnology
- Chemical and Biological Engineering 166 Principles of Cell and Microbe Cultivation

One course from the following:

- Biology 50 Experiments in Biology II
- Biomedical Engineering 175 Tissue Engineering Laboratory
- Biomedical Engineering/Chemical and Biological Engineering 163 Recombinant DNA Techniques
- Chemical and Biological Engineering 168 Biotechnology Processing Projects Laboratory

One course from the following:

- Biology 103 Developmental Biology
- Biology 104 Immunology
- Biology 105 Molecular Biology
- Biology 106 Microbiology
- Biology 153 Topics in Biochemistry
- Biology 177 Topics in Inflammation
- Biology 184 Topics in Developmental Biology
- Chemistry 135 Biophysical Chemistry

- Chemical and Biological Engineering 160 Biochemical Engineering
- Biomedical Engineering/Chemical and Biological Engineering 153 Biomaterials and Regenerative Medicine
- Biomedical Engineering/Chemical and Biological Engineering 154 Tissue Engineering and Regenerative Medicine

GRADUATE PROGRAMS

Tufts sponsors graduate training in biotechnology through joint programs with the departments of ChBE,
BME, biology, and chemistry, and the Gordon Institute of Engineering Management. Master’s degree programs may be entirely course-based (such as the practice-oriented master of engineering degree) or research-based (thesis). Doctoral degree programs may be pursued part-time with a one-year residency requirement. For information about the programs, please refer to the cosponsoring department.

**Biology/Biotechnology (M.S./Ph.D.)**
Degree programs are designed for students whose interests are in molecular biology and the applied aspects of biotechnology, and who prefer a program emphasizing biology rather than engineering (cosponsored by the Department of Biology).

**Biotechnology Engineering (Ph.D.)**
Degree programs are designed for students who are interested in the engineering aspects of biotechnology (sponsored by the Departments of Chemical and Biological Engineering and Biomedical Engineering).

**Chemistry/Biotechnology (M.S./Ph.D.)**
Degree programs are designed for students with interests in chemistry and the applied aspects of biotechnology, and who prefer a program emphasizing the chemical aspects of biotechnology (cosponsored by the Department of Chemistry).

**Engineering Management with Specialization in Biotechnology (M.S.)**
The master’s degree program is designed for working professionals in management or desiring to move into management positions. The program emphasizes a project approach to learning (cosponsored by the Gordon Institute of Engineering Management).

**CERTIFICATE PROGRAMS**
Tufts offers three graduate-level certificate programs to qualified students in conjunction with the departments of biology, chemical and biological engineering, biomedical engineering, and chemistry. The certificate programs can be completed on a part-time, non-degree basis by students who are seeking professional training in the field or preparing for a degree program. In most cases, courses taken as a certificate student can be transferred into a related master’s degree program. The programs are open to students who have already earned a bachelor’s degree. Four courses are required for each certificate.

**Certificate Program in Biotechnology**
The certificate program in biotechnology emphasizes molecular biology practices and state-of-the-art cloning and expression techniques to explore aspects of biotechnology.

Two core courses from the following:
- **Biology 105** Molecular Biology
- **Biology 152** Biochemistry and Cellular Metabolism
- **Biology 153** Topics in Biochemistry
- **Biomedical Engineering/Chemical and Biological Engineering 153** Biomaterials and Regenerative Medicine
- **Biomedical Engineering/Chemical and Biological Engineering 154** Tissue Engineering and Regenerative Medicine
- **Chemistry 171** Organic Chemistry of Living Systems: Biochemistry
- **Chemistry 172** Advanced Biochemistry
- **Chemical and Biological Engineering 161** Protein Purification
- **Chemical and Biological Engineering 162** Molecular Biotechnology
- **Chemical and Biological Engineering 166** Principles of Cell and Microbe Cultivation

One of these three laboratory courses:
- **Biomedical Engineering 175** Tissue Engineering Laboratory
- **Biomedical Engineering/Chemical and Biological Engineering 163** Recombinant DNA Techniques
- **Chemical and Biological Engineering 168** Biotechnology Processing Projects Laboratory

One elective course in biology, chemical and biological engineering, biomedical engineering, or chemistry that is relevant to biotechnology.
Certificate Program in Biotechnology Engineering
The certificate program in biotechnology engineering emphasizes state-of-the-art bioprocessing principles, utilizing industry-based projects and case studies.

Two core courses:
Chemical and Biological Engineering 161 Protein Purification
Chemical and Biological Engineering 166 Principles of Cell and Microbe Cultivation

One laboratory course:
Biomedical Engineering/Chemical and Biological Engineering 163 Recombinant DNA Techniques or
Chemical and Biological Engineering 168 Biotechnology Processing Projects Laboratory or
Biomedical Engineering 175 Tissue Engineering Laboratory

One elective course in biology, chemical and biological engineering, biomedical engineering, or chemistry that is relevant to biotechnology.

For more detailed information, please visit the website http://engineering.tufts.edu/chbe.
Biotechnology and Biotechnology Engineering Certificate Programs

Faculty advisor:
Professor David L. Kaplan, Biomedical Engineering/Chemical and Biological Engineering

The field of biotechnology is vibrant, with constant new developments and advances that are generating opportunities for scientific exploration and employment. New biotechnology-derived pharmaceutical products are gaining FDA approval, the sequencing of the human genome will lead to tremendous new opportunities in disease prevention, and transgenic plants and animals are offering new options in large-scale production of products. The ability to manipulate the genetic content of microbial, insect, animal, and plant cells has led to a variety of commercial applications in medicine, nutrition, materials science, and the environment.

Through industry-based projects and case studies, the certificate courses cover the fundamentals and practical considerations in the field, including construction of recombinant DNA and the production of enzymes, therapeutic proteins, vaccines and small-molecule primary and secondary metabolites. The curriculum features modern techniques for separation and purification of small and large biomolecules, including techniques specially designed for today’s biotechnology products. In addition, production and separation case studies emphasize process economics, GMP, and QA/QC.

The program is open to students with a bachelor’s degree and a background in biology, chemistry, or engineering. Students who lack the necessary biology or engineering background can take primer courses during the summer.

Two certificate programs are available. Each certificate requires four courses.

For more information, contact the program administrator, Angela Foss, at 617-627-2320, or visit http://gradstudy.tufts.edu/programs/certificates/index.htm.
Chemical and Biological Engineering

Professor Kyongbum Lee, Chair; Metabolic engineering, tissue engineering, systems biology
Professor Maria Flytzani-Stephanopoulos, Robert and Marcy Haber Professor in Energy Sustainability; Environmental catalysis, clean energy technologies, nanostructured oxides, fuel cells
Professor Christos Georgakis, Modeling, optimization and process control, batch processing
Associate Professor Jerry H. Meldon, Mass transfer, reaction-separation coupling
Associate Professor Matthew Panzer, Inorganic and hybrid quantum dot/organic optoelectronic devices
Associate Professor Daniel F. Ryder, Modeling, process control, bioprocess engineering
Associate Professor Emmanuel S. Tzanakakis, Stem cell engineering, tissue engineering, computational biology
Associate Professor Hyunmin Yi, Nanobiocraft and nanotechnology, smart biopolymers, BioMEMS
Assistant Professor Ayse Asatekin, Advanced membranes for clean water and separations, macromolecular design, self-assembling polymers
Assistant Professor James Van Deventer, Protein engineering, non-canonical amino acids, cancer, directed evolution, yeast display
Assistant Professor Nikhil Nair, Systems bioengineering, synthetic biology, protein engineering, metabolic engineering
Professor of the Practice Derek Mess, Thermal barrier coating, solid oxide fuel cell ceramics
Research Professor Darryl Williams, Nanobiotechnology, STEM education

SECONDARY APPOINTMENTS:
Professor Linda M. Abriola, Civil and Environmental Engineering; Groundwater hydrology, contaminant fate and transport
Professor David L. Kaplan, Biomedical Engineering; Biotechnology, biomaterials, tissue engineering
Assistant Professor Qiaobing Xu, Biomedical Engineering; Biomaterials, drug delivery, micro/nanofabrication, tissue engineering

Chemical engineering builds on the sciences, especially chemistry and biology, to design processes and products that are useful for society. Chemical engineers tend to be the broadest of all engineers and thus are employed in a wide range of industries. Besides being well-trained in sciences, they appreciate the central role of economics, as they are often concerned with the production of products that will be sold and bought at an affordable price. Their professional skills are required wherever engineering and chemistry or biology intersect. This occurs not only in the chemical industry but also in the biological, environmental, health, legal, and medical fields. Chemical engineers are researchers, designers, producers, and managers. Petroleum, paints, plastics, paper, detergents, pharmaceuticals, vaccines, microchips, drugs, processed foods, fertilizers, conventional and nuclear fuels, insecticides, rocket propellants, synthetic fibers, and rubber are among the many products they help create.

Students who major in chemical engineering have considerable flexibility in choosing a program and are assisted in doing so by a departmental advisor. A student may choose a curriculum leading to the professional degree of Bachelor of Science in chemical engineering or a curriculum leading to the more general Bachelor of Science in engineering. The professional degree curriculum is accredited by the Accreditation Board for Engineering and Technology (ABET) and prepares its recipients for professional practice or graduate study. Most of the recipients of this degree follow various engineering careers. Many students also use the professional degree curriculum as preparation for further study in medicine, law, business, or science.

The general engineering degree curriculum is similar to that of a science major in the College of Liberal Arts. It allows more electives than the professional degree curriculum, as well as more courses in the humanities and social sciences. This curriculum is intended for students who desire an understanding of engineering fundamentals and will make their careers in related fields such as medicine, business and law. This degree is not ABET accredited.

Undergraduates are encouraged to participate in the department’s research programs and independent study for degree credit.

UNDERGRADUATE PROGRAM
Bachelor of Science in Chemical Engineering

The mission of the B.S.Ch.E. degree program offered by the Chemical and Biological Engineering Department is to provide its undergraduate students:
a. A strong foundation in the pure sciences, including biology, chemistry, mathematics and physics.
b. A solid understanding of the fundamental chemical engineering sciences, coupled with quantitative skills, so as to provide a basis for a successful professional career within the technology fields.
c. Training in communication skills consistent with the requirements of both the technical professions and the broader community in which they live.
d. A capacity and desire for the pursuit of lifelong learning. The faculty is committed to accomplishing this mission through the integration of teaching and research.

The goals of the B.S.Ch.E. program are to:

a. Provide students a sound technical foundation in both the traditional and emerging areas of chemical engineering. In particular, the Tufts B.S.Ch.E. program emphasizes the incorporation of the biological sciences into the technical foundation throughout the curricula.
b. Provide quality instruction emphasizing the logical identification and solution of problems; the solution of complex quantitative problems using computational methods; and the application of engineering analysis to the chemical and biological sciences.
c. Offer a high-quality instruction that not only encompasses the technical content but also makes students aware of the societal implications of technology.
d. Provide students the opportunity to formulate, analyze, and solve engineering problems within a team structure, and to communicate their findings in both written and oral forms.
e. Encourage and provide opportunities to sample specialized areas through elective courses, minor programs, industrial internships, and independent research, and as such, to foster an appreciation for lifelong education.

A suggested program of required courses and free electives for the bachelor of science degree in chemical engineering (accredited program) follows.

**First-Year Program**

**FALL TERM**

Engineering Science 93  
Mathematics 32 Calculus I  
Chemistry 1 or 11 Chemical Fundamentals with Laboratory  
English 1 Expository Writing

**SPRING TERM**

Engineering Science 2 Introduction to Computing in Engineering  
Mathematics 36 Applied Calculus II  
Chemistry 2 or 12 Chemical Principles with Laboratory  
Physics 11 General Physics I with Laboratory  
Humanities/social sciences/arts elective

**Sophomore Year**

**FALL TERM**

Chemistry 31 and 33 Physical Chemistry I with Laboratory  
Mathematics 42 Calculus III  
Chemical and Biological Engineering 10 Chemical Process Principles  
Biology 13 or Engineering Science 11 Cells and Organisms with Laboratory or Fundamentals of Biological Systems  
Humanities/social sciences/arts elective

**SPRING TERM**

Chemical and Biological Engineering 11 Chemical Engineering Thermodynamics  
Chemical and Biological Engineering 39 Applied Numerical Methods for Chemical and Biological Engineers  
Mathematics 51 Differential Equations  
Engineering Science 10 Introduction to Materials Science  
Humanities or social sciences elective

**Junior Year**

**FALL TERM**
Chemical and Biological Engineering 21  Transport Phenomena I  
Chemistry 51 and 53  Organic Chemistry I with Laboratory  
Engineering Science 3  Introduction to Electrical Systems with Laboratory  
Humanities or social sciences elective

SPRING TERM

Biology 152  Biochemistry and Cellular Metabolism  
Chemical and Biological Engineering 22  Transport Phenomena II  
Chemical and Biological Engineering 102  Reactor Design  
Chemical and biological engineering elective

Senior Year

FALL TERM

Chemical and Biological Engineering 45  Chemical and Biological Separations  
Chemical and Biological Engineering 51  Chemical and Biological Engineering Unit Operations Laboratory (half credit)  
Chemical and Biological Engineering 109  Process Dynamics and Control  
Chemical and Biological Engineering Foundation elective  
Chemical and Biological Engineering Concentration elective

SPRING TERM

Chemical and Biological Engineering 52  Chemical and Biological Engineering Projects Laboratory  
Chemical and Biological Engineering 60  Product and Process Design  
Chemical and Biological Engineering Concentration elective  
Humanities/social sciences/arts elective  
Free elective

Approved Foundation Elective Courses

Three foundation electives are required and are to be chosen from the following list. Exceptions must be approved by the department.

Chemistry 32  Physical Chemistry II  
Chemistry 42  Quantitative Analysis  
Chemistry 52  Organic Chemistry II  
Chemistry 61  Inorganic Chemistry  
Chemistry 132  Chemical Kinetics and Dynamics  
Chemistry 133  Quantum Mechanics  
Chemistry 135  Biophysical Chemistry  
Chemistry 136  Spectroscopy and Molecular Structure  
Chemistry 141  Instrumental Analysis  
Chemistry 150  Intermediate Organic Chemistry  
Chemistry 151  Physical Organic Chemistry  
Chemistry 152  Advanced Organic Synthesis  
Chemistry 155  Organic Spectroscopy  
Chemistry 161  Advanced Inorganic Chemistry  
Chemistry 162  Chemistry of Transition Elements  
Chemistry 163  Diffraction Methods of Structure Determination

Biology 41  General Genetics  
Biology 46  Cell Biology  
Biology 104  Immunology  
Biology 105  Molecular Biology  
Biology 106  Microbiology  
Biology 134  Neurobiology  
Biology 152  Biochemistry and Cellular Metabolism

Physics beyond Physics 12

For natural science courses accepted towards the Engineering degrees, refer to the School of Engineering list
posted in the student services website. The following Chemical and Biological Engineering course is also accepted as natural science elective in addition to the School of Engineering list:

CHBE 163 Recombinant DNA Techniques

The Senior Honors Thesis in Chemical and Biological Engineering
The Senior Honors Thesis program in ChBE is intended for those students who have a record of high performance in both Foundation and ChBE concentration courses and who have developed an interest and some background in a well-focused research topic. Students interested in writing a Senior Honors Thesis should consult their advisors, the guidelines described under Thesis Honors Program in this bulletin, and the ChBE Department Web pages.

Premedical, Predental, and Preveterinary Preparation via the Chemical Engineering Curriculum
Students interested in entering medical, dental, or veterinary school after graduation can satisfy professional school entrance requirements while working toward a bachelor’s degree in the Department of Chemical and Biological Engineering. Modern medical practice and research is increasingly dependent on engineering methods and devices. Automatic instruments now monitor and assist body function. New synthetic materials repair and even replace body tissue. Mathematical equations that describe the flow of fluids in pipes apply to the flow of blood in veins. The kidney, lung, and heart functions have analogies in chemical engineering process equipment.

Computers are used in diagnosis and research. Given these important areas in medicine, there is a need for students to combine undergraduate engineering with graduate medical training. Two kinds of preparatory programs are suggested by the department. The first is the professional degree program in chemical engineering; a student choosing this program must complete all the requirements for the accredited bachelor of science degree in chemical engineering. Courses required for entrance into medical, dental, or veterinary school are met through selection of electives, summer school, or an increase in course load.

The second program has greater flexibility and leads to the non-accredited bachelor of science degree in engineering, described above. This program gives students a foundation in engineering fundamentals and the possibility of satisfying professional school entrance requirements and pursuing individual interests in other fields through selection of electives.

UNDERGRADUATE MINOR PROGRAMS
In addition to completing the courses for the concentration requirement, an undergraduate may elect to enroll in a minor program in a different, although possibly related field. All courses used in fulfillment of the minor program must be taken for a grade. No more than two courses used to fulfill a foundation or concentration requirement may be counted toward fulfillment of the minor. Students may not complete both a minor and a concentration in the same discipline.

Biotechnology Engineering Minor
Five courses are required to obtain this minor: Biology 152 or Chemistry 156; two courses from the following: Chemical and Biological Engineering 62, 161, or 166; one course from the following: Biology 50, Chemical and Biological Engineering 163 or 168; and an elective chosen from an approved list. No more than two courses used to fulfill a foundation, distribution, or concentration requirement may be counted toward the minor.

Chemical Engineering Minor
Five courses are required: Chemical and Biological Engineering 10, 11, 39, 102; and a chemical engineering elective approved by the minor committee. All courses must be taken for a grade. No more than two courses used to fulfill a foundation, distribution, or concentration requirement may be counted toward the minor.

SECOND MAJOR IN BIOTECHNOLOGY
This program is offered as a major only in conjunction with enrollment in a regular undergraduate major, ordinarily excluding interdisciplinary programs. The biotechnology program has been designed with two tracks: a science track for undergraduate students enrolled in the College of Liberal Arts, and an engineering track for undergraduate students enrolled in the School of Engineering.

Core Curriculum
Biology 1 Introduction to Biology or Biology 13 Cells and Organisms
Biology 41 Genetics
Molecular Biotechnology

One laboratory course from:

- Biology 50 Experiments in Molecular Biology
- Chemical and Biological Engineering 163 Recombinant DNA Techniques
- Chemical and Biological Engineering 168 Biotechnology Processing Projects Laboratory

Track curricula

**SCIENCE TRACK**

Two core courses:

- Biology 105 Molecular Biology
- Biology 152 Biochemistry and Cellular Metabolism

Four electives from an approved list provided by the department. Up to two credits of research may be counted toward electives.

**ENGINEERING TRACK**

Two core courses:

- Chemical and Biological Engineering 161 Protein Purification
- Chemical and Biological Engineering 166 Principles of Cell and Microbe Cultivation

Four electives from an approved list provided by the department. One credit of research may be counted toward electives.

**CERTIFICATE PROGRAMS**

The Chemical and Biological Engineering Department offers three graduate-level certificate programs to qualified students through the Office of Graduate Studies. The certificate programs, Biotechnology, Biotechnology Engineering and Bioengineering, can be completed on a part-time, non-degree basis by students who are seeking professional training in the field or preparing for a degree program. In most cases, courses taken as a certificate student can be transferred into a related master’s degree program. The programs are open to students who have already earned a bachelor’s degree. Four courses are required for each certificate.

A certificate builds on the strength of existing Tufts courses and programs. As a certificate student, you have the flexibility to choose courses that were created exclusively for a certificate program, as well as the traditional Tufts graduate and undergraduate courses. In order to accommodate working professionals’ schedules, most certificate courses are offered in the late afternoon and evening.

Certificate students may apply later for a related master’s or doctoral program at Tufts. Once you have been accepted, you are permitted to transfer four applicable certificate courses into a graduate program.

**GRADUATE PROGRAM**

The Department of Chemical and Biological Engineering offers instruction leading to the degrees of master of science, master of engineering, and doctor of philosophy. General GRE test scores are required of applicants to all graduate degree programs.

**Master of Science or Master of Engineering with Major in Chemical Engineering**

Candidates for the master’s degree programs in chemical engineering usually hold a bachelor of science degree in chemical engineering or in chemistry, with a suitable background in engineering subjects. A strong background in mathematics, biology, chemistry, and physics is essential. Students with degrees in physical science or other engineering disciplines may become candidates upon satisfactory completion of certain upper-level undergraduate courses. A highly recommended alternative to formal enrollment in academic-year, undergraduate chemical engineering courses is the intensive two-course summer sequence of Chemical and Biological Engineering 1 and 2, which are offered periodically. Successful completion of these courses qualifies a student to apply to the master’s degree programs.

Students enrolled in the Master of Science degree program must take seven courses for letter grades. No more than one of these seven may be guided individual study. Generally, at least five credits are from a list of chemical engineering courses; the remaining courses may be in allied fields. A thesis (three credits) is also required, along with an oral examination covering the field of the student’s thesis. Only students in the Master of Science degree program may apply for financial assistance.

Students enrolled in the Master of Engineering degree program must take ten courses for letter grades.
Generally, at least eight credits are from a list of chemical engineering courses; the remaining courses may be in allied fields.

**Master of Engineering or Master of Science with Major in Bioengineering: Cell and Bioprocess Engineering**

Cell and Bioprocess Engineering is a new track option of the master’s degrees in Bioengineering offered by the School of Engineering. Candidates for this track usually hold a bachelor of science degree in chemical or biochemical engineering with a suitable background in chemical and biological sciences. Candidates with degrees in biology, biochemistry and strong background in mathematics, chemistry, and physics will also be considered. Students with degrees in physical science or other engineering disciplines who have no background in biology may become candidates upon satisfactory completion of appropriate undergraduate courses. For students without undergraduate engineering degrees, a highly recommended alternative to formal enrollment in academic-year undergraduate chemical engineering courses is the intensive two-course summer sequence of Chemical and Biological Engineering 1 and 2, which are offered periodically. Successful completion of these courses qualifies a student to apply for the master’s program. All Bioengineering master’s degree candidates must take a common core curriculum totaling four credits. Candidates of the Cell and Bioprocess Engineering track must also take four required courses from a list of approved track-specific courses. An additional two graduate-level elective courses are needed to complete the ten-credit Master of Engineering degree. Students accepted into the program will have the option of petitioning the admissions committee to pursue a Master of Science degree. A student petitioning the committee must have identified a research advisor who agrees to accept the student to their laboratory. Students enrolled in the Master of Science degree program must complete a two-credit thesis (in lieu of the elective credits) in addition to the eight credits of coursework.

**Doctor of Philosophy**

Doctoral degrees are offered both in Chemical Engineering and in Biotechnology Engineering. Candidates for the Doctor of Philosophy degree, except when otherwise recommended by the department, will have completed the seven courses required for the Master of Science degree. A qualifying examination must be satisfactorily completed. This examination is usually taken after one full year of residence.

In addition to satisfying the university requirements for the Doctor of Philosophy degree, a candidate must satisfactorily complete a program of courses (established by the candidate’s committee) and write a doctoral dissertation. The doctoral dissertation is considered the candidate’s major task. It must represent a significant contribution to the field and contain material worthy of publication in a recognized professional journal.

For more detailed information, please visit the website [http://engineering.tufts.edu/chbe](http://engineering.tufts.edu/chbe).
Chemical Physics

(FOR DEGREE REQUIREMENTS, SEE CHEMISTRY OR PHYSICS.)
Chemistry

Professor Krishna Kumar, Chair; Robinson Professorship in Chemistry, Organic chemistry and chemical biology
Professor Terry E. Haas, Physical inorganic and materials chemistry
Professor Jonathan E. Kenny, Physical and environmental chemistry
Professor Samuel P. Kounaves, Analytical, environmental, and planetary chemistry
Professor Elena Rybak-Akimova, Inorganic and bioinorganic chemistry
Professor Mary Jane Shultz, Surface chemistry, environmental and materials chemistry
Professor Robert D. Stolow, Organic chemistry, conformational studies
Professor E. Charles Sykes, Physical chemistry
Professor David R. Walt, University Professor, Bioorganic and materials chemistry
Associate Professor Albert Robbat Jr., Analytical chemistry
Associate Professor Samuel W. Thomas III, Organic and materials chemistry
Associate Professor Arthur L. Utz, Physical and materials chemistry
Associate Professor Clay Bennett, Bioorganic, chemical biology and synthetic chemistry
Associate Professor Joshua A. Kritzer, Bioorganic chemistry and chemical biology
Assistant Professor Yu-Shan Lin, Theoretical and biophysical chemistry
Assistant Professor Charles R. Mace, Bioanalytical and materials chemistry
Assistant Professor Rebecca A. Scheck, Bioorganic chemistry and chemical biology
Senior Lecturer Sergiy Kryatov, Inorganic chemistry and chemical education
Lecturer Diren Pamuk Turner, Biochemistry and chemical education

Chemistry, the central science, offers exciting challenges to professionals who seek a fundamental understanding of the world we live in, and creative solutions to the problems confronting the global community. Chemistry offers more than hope in our attempts to feed, clothe, and house our burgeoning populations: It offers possibilities. In the search for renewable substitutes for scarce energy sources and minerals, chemistry provides the basic framework for materials scientists. As the medical community fights to conquer new and old diseases and improve the health of our populations, chemical principles guide the paths of investigators, suggesting correlations in results, and pointing the way toward ultimate solutions.

On a national level, chemistry provides the key to the future. In monitoring, cleaning up, and protecting our environment, chemistry can and must be wisely applied. The U.S. chemical industry remains one of the healthiest branches of the national economy: it employs almost a million people in high-paying manufacturing jobs. Chemicals are one of the few commodity groups in which the U.S. has maintained a good international trade balance during the past decade. From community health to economic well-being, chemistry can be expected to maintain its preeminent role in shaping and protecting our nation’s future.

The study of chemistry is appropriate to many different career goals, including medicine, law, physical and social sciences, engineering, and public policy. The Department of Chemistry at Tufts is well equipped to provide basic and advanced chemistry education to undergraduates. It offers a wide variety of courses, newly expanded and improved facilities, an active teaching and research faculty, and a favorable faculty-to-student ratio. Students who participate in research receive a great deal of personal attention from their faculty advisor, and have excellent opportunities for undertaking senior projects and honors theses. They may choose from a broad range of research projects, because the faculty is involved in all the traditional areas of chemical research, as well as many of the exciting new interdisciplinary endeavors.

UNDERGRADUATE CONCENTRATION REQUIREMENTS
The chemistry department offers four majors: 1) an American Chemical Society (ACS)–certified major, 2) a chemistry major, 3) a chemical physics major, and 4) a biochemistry major. Each of these four majors must be completed with a minimum GPA of 2.00 for the courses applied to the major. Additionally, no more than one course (of any credit value) with a grade below a C- may be applied to any of these majors. The ACS-certified degree includes a certificate issued by the American Chemical Society and is recommended for those whose career goals include employment as a professional chemist or scientist, involvement in research, or graduate school in chemistry. Courses leading to a certified major include research that offers students an opportunity to work closely with members of the department’s renowned research faculty. The major in chemical physics is intended for those students who desire a more theoretical, physics-oriented education. The biochemistry major is recommended for those students with an interest in biologically oriented chemistry. The chemistry major offers greater flexibility in course selection. Students with interest in any of these majors should look for more information on the department’s website at http://chem.tufts.edu.
ACS-Certified Major in Chemistry
Foundation: Chemistry 1, 11 or 16 and Chemistry 2 or 12. Core courses: Chemistry 31, 32, 33, 34, 42, 51, 52, 53, 54, 61, 63, 171, and one additional course in intermediate or advanced chemistry that has one of the following courses as a prerequisite: Chemistry 31, 32, 42, 52, 61, or 171. Research: Chemistry 81 and 82 (or Chemistry 195 and 199, Senior Thesis). Also required are Mathematics 32 and 34 (or 39 and 44) and Physics 1 (or 11) and 2 (or 12). For more information please visit the department’s website at http://chem.tufts.edu.

Major in Chemistry
Foundation: Chemistry 1, 11, or 16 and Chemistry 2 or 12. Intermediate: Chemistry 31, 33, 42, 51, 52, 53, 54; four additional courses in intermediate or advanced chemistry, excluding Chemistry 34. Two of the four additional chemistry courses may be substituted with intermediate or advanced courses in related fields (for details, please visit the department’s website at http://chem.tufts.edu). Only one course of undergraduate research, either Chemistry 82 (Research II) or Chemistry 199 (the second semester of Senior Thesis) may be counted toward the four additional courses in intermediate or advanced chemistry. Also required are Mathematics 32 and 34 (or 39 and 44) and Physics 1 (or 11) and 2 (or 12).

Major in Chemical Physics
Foundation: Chemistry 1, 11, or 16; Chemistry 2 or 12; Physics 1 or 11; Physics 2 or 12. Concentration: Ten credits of more advanced, one-credit courses—four credits in Chemistry (with a prerequisite of Chem 2 or 12), four credits in Physics (with a prerequisite of Phys 2 or 12), and two credits in mathematics (Math 70 or courses with a prerequisite of Math 42, 44, or 70). The courses must include the following: Physics 13; one credit in advanced laboratory training, either Physics 64 (counts as one advanced physics course) or both Chemistry 33 and 34 (count as one advanced chemistry course); either Chemistry 31 or Physics 52; either Chemistry 32 or Physics 61; and either Chemistry 51 or Chemistry 61. Faculty advisors in the chemistry and physics departments are available for consultation on the chemical physics program.

Major in Biochemistry
Chemistry 1, 11, or 16 and Chemistry 2 or 12; Chemistry 51/53, 52/54, 31, 42, 171, and 172; Biology 13, 41, 50 (or Chemical and Biological Engineering 163), and 105. Course work in mathematics (Mathematics 34) and physics (Physics 2 or 12) is required as a prerequisite to Chemistry 31. The following sequence of courses is suggested for students concentrating in biochemistry: first year, Chemistry 1 (or 11) and 2 (or 12), Biology 13, Mathematics 32; second year, Chemistry 51/53, 52/54, and 171, Mathematics 34, Physics 1 and 2 (or 11 and 12); third year, Chemistry 172, Biology 41, 105, and 50 (or Chemical and Biological Engineering 163); fourth year, Chemistry 31 and 42. To be eligible for summa cum laude, a student majoring in biochemistry must have done biology or chemistry research equivalent to Biology 93 or Chemistry 81.

GRADUATE PROGRAM
The Department of Chemistry offers M.S. and Ph.D. degrees in chemistry, chemistry/biotechnology and chemical physics. Students interested in the joint chemistry/biotechnology or chemical physics program should look for more information on the department’s website at http://chem.tufts.edu.

In the first year of graduate study, entering students meet with the department’s graduate committee and are placed into a series of core courses in each of the traditional areas of chemistry: analytical, inorganic, organic, and physical. These courses are intended to ensure that by the end of the first year the student has an adequate grounding in the fundamentals of chemistry. Each student then takes additional advanced courses in his/her area of specialization.

Master of Science
A candidate for the master of science degree in chemistry is expected to have a satisfactory background in physics, mathematics, and chemistry. All master’s degree candidates are required to pass (B- or better) eight formal classroom graduate courses in chemistry or approved, related fields. Four of these courses must be in chemistry. Two may be approved independent study (293, 294). Alternatively, a student may elect to take six formal classroom courses and two credits of research (295, 296). The courses must be chosen in consultation with the graduate committee; Students may also elect to prepare a master’s thesis which they must then present and defend before their research committee.

Doctor of Philosophy
The doctorate in chemistry is awarded to students who have demonstrated a broad familiarity with the science of chemistry and a thorough knowledge of their specialized field, and who have displayed competence
in planning and conducting chemical research.

By the end of the third semester, each graduate student must pass (with a B- or higher) one formal classroom course in each of the four traditional areas of chemistry. At least six formal graduate courses in chemistry (exclusive of research) are required for the degree and must be completed satisfactorily by the end of the fourth semester. Additional courses in chemistry or related fields may be required by individual research supervisors. Selection of a research supervisor is usually made during the first year on the basis of common interest. The student and research supervisor nominate two faculty members to serve on the student’s doctoral committee. The doctoral committee (in conjunction with the student’s research advisor) takes over the advisory function from the graduate committee and guides the student’s research to promote his/her development as an independent investigator.

Doctoral students must also satisfy the following requirements:
1) Serve as a teaching assistant
2) Present a research topic to the research committee by the end of the third semester
3) Present a study topic as a public seminar and defend it in a private meeting with the research committee by the end of the fourth semester
4) Submit a third-year research report to the research committee by the end of the sixth semester
5) Prepare and defend an original research proposal by the end of the eighth semester
6) Defend a thesis

The department is actively engaged in research in the areas of organic, inorganic, physical, and analytical chemistry, as well as the interdisciplinary areas of bioorganic, environmental, and materials chemistry. For more information concerning research interests, facilities, and financial aid, please see the booklet Graduate Program in Chemistry, available on the department’s website at [http://chem.tufts.edu](http://chem.tufts.edu).
Professor David Henry Feldman, Chair; Cognitive development, developmental and educational theory, creativity

Professor Marina Bers, Math, Science and Technology/Engineering Initiative; Educational technology, impact of new technologies for personal, social and moral development, use of technology in hospitals, museums, schools and communities

Professor M. Ann Easterbrooks, Family development, social and emotional development, infancy

Professor Richard M. Lerner, Bergstrom Chair in Applied Research in Youth Development; Director, Institute for Applied Research in Youth Development; Application of developmental science across the life span, personality and social development in adolescence, university-community collaboration and outreach scholarship

Professor Maryanne Wolf, John DiBlagio Chair in Citizenship and Public Service; Director, Center for Reading and Language Research; Dyslexia, cognitive neurosciences, cognition, developmental psycholinguistics, reading development and intervention

Associate Professor Kathleen A. Camara, Family relationships, social development, research methodology

Associate Professor Calvin Gidney III, Linguistics, literacy, sociolinguistic development, language of African-American children, language in children's television, development of children's language attitudes

Associate Professor Francine Jacobs, Child and family policy, program evaluation

Associate Professor Tama Leventhal, Neighborhood influences on children, youth, and families; social policy

Associate Professor Christine McWayne, Early childhood education; low-income, urban-residing children's school success; family engagement in children's early education; community-based research collaborations

Associate Professor Jayanthi Mistry, Cultural perspectives on development; navigating multiple cultural worlds and identities; interpretive methods in the study of children and families

Associate Professor Ellen E. Pinderhughes, Influences on family socialization processes among families with children at risk for problematic outcomes; adoption and foster care

Assistant Professor Sasha Fleary, Pediatric psychology, child health

Assistant Professor Sara K. Johnson, Civic engagement, identity development, advanced statistical methods

Senior Lecturer Julie Dobrow, Director, Communication and Media Studies; Effects of media on children, ethnic and gender representations in media

Senior Lecturer Martha Pott, Coordinator of Capstone Internships for M.A. Applied Program; Education, personal-social development

Senior Lecturer W. George Scarlett, Deputy chair; Children's play; religious and spiritual development; behavior and classroom management; organized youth sports

Lecturer Cynthia Ballenger, Early childhood education, culture and early childhood education, sociolinguistics

Lecturer Bruce Johnson, Early childhood curriculum, early care and education policy, teacher professional development

Lecturer Kerri Modry-Mandell, Fieldwork Administrator; Pediatric psychology, developmental psychopathology

SECONDARY APPOINTMENTS:

Adjunct Professor Laurie Miller, Professor of Pediatrics and Adjunct Professor of Nutrition (Friedman School); Medical and developmental issues related to international adoption, health, nutrition, and developmental studies of rural children in Nepal and Uganda; interventions to improve nutritional outcomes

Affiliated Lecturer Renata Celichowska, Director of Dance, Department of Drama and Dance; Children's movement and dance education

Associate Research Professor Jessica Goldberg, Tufts Interdisciplinary Evaluation Research (TIER)
Assistant Research Professor Kristina Schmid Callina, Institute for Applied Research in Youth Development, The role of hope in Positive Youth Development; Educational and out-of-school time programs to promote char-
The Department offers an interdisciplinary array of courses and experiences, which are complemented with observations and field work with children in a wide range of applied settings, including hospitals, schools, clinics, day care centers, educational television studios, museums, and juvenile courts. Students completing the Child Study and Human Development major select from the following areas of specialization or focus: child and family health, early childhood education, developmental theories, children and the arts, technology and media, and child and family policy. Those majoring in child study and human development receive a strong foundation in applied developmental science, an interdisciplinary field that generates and uses theory and research about human development to improve the lives of children, youth, and families around the world.

Students who complete the major are likely to continue on to graduate work in child-related disciplines (e.g., pediatrics, clinical child psychology), or employment in various fields, such as early childhood education, clinical psychology, pediatric psychology, law and juvenile justice, public policy, and other disciplines that have the health, education, and welfare of children as their primary goal. For those preparing for careers in early childhood education, the Department offers a teacher preparation program leading to preK-2nd grade initial licensure that students can complete as undergraduates (provided they are admitted into this program by their first semester of junior year), as well as a 4 + 1 joint BA/MAT program leading to preK-2nd grade initial licensure. See below for more details.

DEPARTMENT FACILITIES

Eliot-Pearson Children’s School
Architecturally attached to the Department of Child Study and Human Development, the Eliot-Pearson Children’s School is a laboratory school serving eighty children ages 2.9 to 8 (preschool through second grade). Classrooms are fully integrated, including children with special needs and children and families from diverse cultural and economic backgrounds. The school is an exemplary early-childhood program, modeling innovative developmental education and curricula. Observation facilities and practicum sites provide exceptional training and research opportunities for Tufts undergraduate and graduate students and early-childhood professionals from across New England. The children’s school also offers a range of programming for parents and families. For more information, visit http://ase.tufts.edu/epcs/.

Evelyn G. Pitcher Curriculum Resource Laboratory
Adjoining the department is the Evelyn G. Pitcher Curriculum Resource Lab, a multi-purpose space with art/workshop studio, computers to access curricular resources online, seminar space with audio-visual capabilities, and a lending library of resource books and early childhood classroom materials. The lab hosts workshops, seminars and conferences for Tufts students, alumni and early childhood teachers and administrators from surrounding cities and towns, focusing on evidence-based best practices that support children’s language and literacy development as well as science, technology, engineering, mathematics, and nature studies/sustainability education in urban settings. For more information, visit http://ase.tufts.edu/pitcherCurriculumLab/.

Institute for Applied Research in Youth Development
The institute creates programs and projects that use the framework of applied developmental science to promote healthy, positive development among diverse children, adolescents, families, and communities. For more information, visit http://ase.tufts.edu/iaryd.

Center for Reading and Language Research
The center offers a variety of research, teaching, and internship opportunities to students and faculty and a
range of services to the surrounding communities. For more information, visit [http://ase.tufts.edu/crlr](http://ase.tufts.edu/crlr).

**Developmental Technologies Research Group (DevTech)**
Established and directed by Dr. Marina Umaschi Bers, DevTech aims to understand how new technologies can play a positive role in children’s development and learning. [http://ase.tufts.edu/devtech/](http://ase.tufts.edu/devtech/).

**Tufts Interdisciplinary Evaluation Research (TIER)**  (formerly Massachusetts Healthy Families Evaluation)
Tufts Interdisciplinary Evaluation Research (TIER) is committed to conducting high-quality, collaborative evaluation research that contributes to expanding usable knowledge in fields such as applied developmental science, policy science, and urban planning, and to improving policies and programs for children, families, and communities. [http://ase.tufts.edu/tier/about/index.htm](http://ase.tufts.edu/tier/about/index.htm).

**UNDERGRADUATE CONCENTRATION REQUIREMENTS**

**Major in Child Study and Human Development**
The major in Child Study and Human Development requires ten courses, including Child Development 1 (no substitutes allowed), and an additional course with a developmental theory focus. With departmental approval, one “related fields” course can be from outside the department. Students are required to have at least one fieldwork or research experience as well as three courses from within one of the Department’s four areas of specialization or focus (see above). Please see the Department’s website at [http://ase.tufts.edu/epcshd/undergraduate](http://ase.tufts.edu/epcshd/undergraduate) for complete information on requirements.

**Early Childhood (Pre-K to Grade 2), 4 + 1, Joint B.A./M.A.T. Program**
With a focus on urban education, students choosing this option will receive a B.A. in Child Study and Human Development (10 credits) and then an M.A.T. after one more year. During their undergraduate years, the students will need to take two courses in Child Study and Human Development beyond the requirement for the B.A. These courses will be credited towards the M.A.T. degree. The M.A.T. year includes a significant tuition reduction as well as the possibility of other financial aid. See description below of the M.A.T. program.

**UNDERGRADUATE MINOR PROGRAM**
The Department of Child Study and Human Development offers a minor in child study and human development. Five courses are required, two of which are to be chosen from Child Development 1, 51 or 151, 61 or 161, and 155. Three additional electives are to be chosen from other course offerings within the department.

**AMERICAN SIGN LANGUAGE (ASL)**
The department offers three levels of American Sign Language. Undergraduates completing all three can have ASL fulfill Part I or Part II of the foreign language (foundation) requirement.

**GRADUATE PROGRAMS**
The Department of Child Study and Human Development offers the master of arts degree, a joint master of arts degree with the Department of Urban and Environmental Policy and Planning, the master of arts in teaching (M.A.T.) degree, and the Ph.D. degree. Along with the standard material sent to the graduate school, applicants for admission to these graduate programs must include a statement of two to three type-written pages describing their motivation for applying for graduate work in child study and human development and the ways in which they envision using the education received at Tufts. Except in the case of Tufts undergraduate seniors, scores from the Graduate Record Examination are required. The deadline for applications is January 1, although applications received after January 1 are considered, based on the availability of places. For more detailed information please visit the website [http://ase.tufts.edu/epcshd/graduate](http://ase.tufts.edu/epcshd/graduate).

**Master of Arts (M.A.)**
The master of arts degree requires the satisfactory completion of a ten-credit course of study. Students interested in engaging in child study and human development research conclude the program by writing a thesis; students interested in the more applied, practical aspects of child study and human development conclude
the program with an intensive supervised internship. Each route offers a combination of required and elective courses. The M.A. degree program serves child study and human development students with a broad range of professional and intellectual interests. Graduates enter positions in human services agencies, research organizations, schools and early childhood programs, advocacy groups, and institutions of higher education. A significant percentage of graduates continue their studies in Ph.D., Psy.D., and other programs in developmental or clinical psychology; in law schools; in medical schools; and in other degree-granting post-MA programs.

Master of Arts (M.A.) Program with Urban and Environmental Policy and Planning
The master of arts degree offered jointly by the Department of Child Study and Human Development and the Department of Urban and Environmental Policy and Planning is a fourteen-credit graduate program in child and family policy. Students matriculate in two nationally renowned departments at Tufts and fulfill the general requirements for each, including courses in developmental psychology, policy planning and analysis, and research methods and statistics. In addition, they follow a specific course of study in child and family policy, culminating in a master’s thesis. Contact either department for more information.

Master of Arts in Teaching (M.A.T.) Early Childhood (PK-Grade 2)
This two-year (12.5 credits) program is committed to preparing early childhood teachers for urban education settings. In addition to a focus on early childhood curriculum and pedagogy, coursework and field placements emphasize multidisciplinary study of poverty and declining city neighborhoods’ effects on children and families, immigrant families and their young dual language learners, and social and educational policy. Particular signatures of the program include Science, Technology, Engineering, and Mathematics (STEM) teaching and learning; a focus on teaching and learning with dual language learners (DLLs); and inclusive classroom settings. Students integrate a developing theoretical understanding of the unique needs and abilities of young learners with extensive practical experiences in our lab school (http://ase.tufts.edu/epcs/) and in urban public school classrooms.

Doctor of Philosophy (Ph.D.)
The doctoral program in child study and human development prepares individuals for either academic or applied settings involving children, youth, and their families. Such settings include schools, hospitals, social service agencies, the arts and media, courts, clinical research centers, and policy organizations, as well as colleges and universities. Accordingly, intensive training in theory and research methodology is involved, as well as extensive field experience. Applicants should have a strong background in the behavioral sciences.

Course work during the first two years emphasizes the major theoretical orientations of the field and research methods and statistics. The remaining courses are selected in accordance with the student’s academic plan, which is decided by the student and his or her advisors.

On completion of course work and an internship, students are required to undergo a qualifying review. Two major papers related to theory and research in child study and human development are submitted, and the student’s progress and course of study in the doctoral program are reviewed. Successful completion of this review is a prerequisite to further doctoral study.

Internships are selected according to the participant’s career interests, with students serving as supervised trainees in the service and research functions of the particular setting. The remainder of the program is devoted to participation in research and the completion and defense of a dissertation.

Ph.D. in Human Developmental Economics (HDE)
The Eliot-Pearson Department of Child Study and Human Development (CSHD) and the Economics Department offer a joint Ph.D. program in Human Developmental Economics (HDE). This interdisciplinary doctoral program provides theoretical and methodological training in human development through the integrative study of social, emotional, economic, and behavioral processes as they contribute to socialization, decision making, and positive human development. Training involves course work in both departments, field work, theoretical and empirical qualifying papers, and dissertation research. Students focus their dissertation study in economics or human development based on the electives taken.

For more detailed information, please visit the website http://ase.tufts.edu/epcsdh.
Chinese

(FOR DEGREE REQUIREMENTS, SEE GERMAN, RUSSIAN, AND ASIAN LANGUAGES AND LITERATURES.)
Civil and Environmental Engineering

Professor Kurt D. Pennell, Chair, Bernard M. Gordon Senior Faculty Fellow in Environmental Engineering; Contaminant remediation, engineered nanomaterials, environmental toxicology, metabolomics

Professor Linda M. Abriola, University Professor; Groundwater hydrology, multiphase flow and transport in porous media

Professor Laurie G. Baise, Geotechnical and geosystems engineering, seismic hazard analysis, geohazards

Professor Steven C. Chapra, Louis Berger Chair of Civil and Environmental Engineering; Water quality modeling, advanced computer applications in environmental engineering

Professor Luis Dorfmann, Structural engineering and solid mechanics

Professor David M. Gute, Environmental and occupational epidemiology

Professor Daniel A. Kuchma, Design, behavior, and modeling of concrete structures

Professor Shafiqul Islam, Hydroclimatology, hydroepidemiology, water diplomacy

Professor Masoud Sanayei, Structural engineering, bridge structural health monitoring, building floor vibrations

Emeritus Professor Linfield C. Brown, Water quality modeling, environmental engineering and statistics

Emeritus Professor Lewis Edgers, Geotechnical and geo-environmental engineering

Emeritus Professor Richard M. Vogel, Water resources, environmental statistics, hydrology and hydraulics

Associate Professor Wayne Chudyk, Drinking water quality and toxic materials, groundwater monitoring

Associate Professor John L. Durant, Chemical fate and transport, water quality, urban air pollution

Associate Professor Stephen H. Levine, Environmental, ecological and economic systems modeling

Associate Professor Babak Moaveni, Structural engineering, structural health monitoring, structural dynamics

Associate Professor C. Andrew Ramsburg, Environmental remediation, emerging contaminants, water reuse

Associate Professor Christopher Swan, Associate Dean, Jonathan M. Tisch College of Civic Life; Geotechnical and geo-environmental engineering

Assistant Professor Daniele S. Lantagne, Public health engineering, global health, water-borne pathogens

Assistant Professor Robert C. Viesca, Applied mechanics in earth sciences and engineering

Professor of the Practice Brian Brenner, Bridge design, structural engineering

Professor of the Practice Eric M. Hines, Structural engineering

Professor of the Practice James F. Limbrunner, Hydrology, integrated water resources management

Research Professor John T. Germaine, Geotechnical, laboratory testing, soil behavior, physical properties

Research Assistant Professor Natalie L. Cápiro, Environmental biotechnology and bioremediation

Senior Lecturer Mark A. Woodin, Environmental and occupational epidemiology

Emeritus Senior Lecturer Lee R. Minardi, Computer-aided design, geographic modeling, applied mechanics

Lecturer Anne Marie C. Desmarais, Environmental health

SECONDARY APPOINTMENTS:

Adjunct Professor Doug Brugge, Tufts University School of Medicine; Public health, community medicine

Adjunct Professor Grant Garven, Earth and Ocean Sciences; Groundwater geology and hydrology

Adjunct Professor Jeffrey K. Griffiths, Tufts University School of Medicine; Global health, infectious diseases

Adjunct Professor Mark Kachanov, Mechanical Engineering; Solid mechanics, applied mathematics

Adjunct Professor Elena Naumova, Associate Dean; Gerald J. and Dorothy R. Friedman School of Nutritional Science and Policy, Public health, infectious diseases, biostatistics, epidemiology, nutrition and growth

PART-TIME FACULTY:

Visiting Scholar Richard P. Hooper, Hydrology and catchment biogeochemistry, information systems

Visiting Scholar Annette T. Huber-Lee, Integrated water and land planning, economics of water

Visiting Scholar Paul H. Kirshen, Water resources planning and management, impacts of climate change

Lecturer Po-Shang Chen, Structural Engineering

Lecturer David J. Hatem, Professional and Legal issues

Lecturer Magaly Koch, Remote sensing and geographic information systems

Lecturer Michael Paster, Geotechnical engineering

Lecturer Damian R Siebert, Geotechnical Engineering

Lecturer Stephen G. Zemba, Air pollution control

Civil and Environmental Engineering (CEE) is one of the most diverse engineering disciplines, encompassing environmental and water resources engineering, geosystems engineering, public health engineering, and structural engineering. Civil and environmental engineers are responsible for the planning, design, construc-
tion, and operation of structures and facilities that are essential to the environment and infrastructure of a sustainable society. Traditionally these structures included buildings, highways, water and waste treatment plants, tunnels, airports, harbors, railroads, bridges, and dams. Today, civil and environmental engineers are involved in a wide range of engineered and natural systems that contribute to a modern society and protect the environment and public health. These activities include the development and testing of new materials, structural health monitoring and rehabilitation, management and protection of watersheds and water supplies, mathematical modeling of built and natural environments, bioremediation and exposure assessment.

Structural engineers are involved in the planning, design and monitoring of buildings, bridges, dams, vehicle frames, and special structures such as power transmission towers and wind turbines. The activities of structural engineers range from analysis and design of basic structural components such as beams, columns and floor slabs to the study of material properties and biomechanics.

Geosystems engineers specialize in the study of soil and rock mechanics and in the analysis of problems of soil response to loads, groundwater flow, and environmental contaminants. Geosystems engineers evaluate the hazard related to landslides and earthquakes and design a variety of earth structures such as dams, embankments, landfills and containment structures for hazardous waste sites, as well as foundations for bridges, buildings, and offshore platforms.

Environmental engineers seek to protect human health and the environment through the planning and design of air and water pollution control facilities, treatment and disposal of hazardous wastes, and the development of treatment technologies for persistent and emerging contaminants such as nanomaterials and chlorinated solvents. Water resource engineers are concerned with the planning, design and operation of water resource systems and the restoration of rivers and watersheds. Water resource engineers are involved in projects ranging from flood control works to hydropower stations, water supply systems, and storm-water systems.

Public health engineers assess the impacts of environmental exposures to biological, chemical and physical hazards on human health, design engineered controls for water-borne diseases and other human health risks, and measure and predict the effects of environmental factors on the occurrence and transmission of disease.

UNDERGRADUATE PROGRAM

The Department of Civil and Environmental Engineering (CEE) offers two primary undergraduate degrees: the Bachelor of Science in Civil Engineering (B.S.C.E.) and the Bachelor of Science in Environmental Engineering (B.S.E.E.). The programs leading to the B.S.C.E. and B.S.E.E. degrees are accredited by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET), and satisfy the degree requirements needed to take the Fundamentals of Engineering (FE) examination, an important step toward registration as a licensed professional engineer. Depending upon a student’s background and interests, there are numerous opportunities to utilize advanced placement credits, obtain a minor, complete dual majors, and participate in study abroad and internship programs. The overall goals of the B.S.C.E. and B.S.E.E. programs are for students to learn the fundamental engineering principles, to master engineering methods for solving challenging problems, and to effectively communicate engineering solutions to both technical and non-technical audiences. The CEE faculty is dedicated to accomplishing these goals through the integration of teaching, research, and professional practice.

Bachelor of Science in Civil Engineering

B.S.C.E. degree program prepares students for a career in civil and environmental engineering. The B.S.C.E. provides instruction in one of four subareas: environmental engineering, geotechnical engineering, structural engineering, and water resources engineering. The mission of the B.S.C.E. program is to provide students with an educational experience that builds a sound foundation for professional practice and provides technical skills that serve as a basis for career advancement and life-long learning. Program objectives are achieved by developing a broad understanding of civil and environmental engineering, fundamental engineering principles, and connections with the humanities, arts, and social sciences. The curriculum emphasizes the application of basic sciences, computing, and mathematics for engineering design. Students completing the B.S.C.E. program are also well qualified for graduate study in engineering, architecture, construction, business management, and law.

DEGREE REQUIREMENTS

The B.S.C.E. program is accredited by the Engineering Accreditation Commission of ABET (www.abet.org). Following the guidelines of the School of Engineering, a total of thirty-eight courses are required to fulfill the B.S.C.E. degree requirements. Of these thirty-eight course credits, a minimum of 9.5
Course credits must be completed in college-level math and basic science subjects appropriate to the discipline, and a minimum of 14.5 course credits must be completed in engineering topics, consistent with ABET general and program criteria. Introductory science and engineering requirements account for ten courses, with six humanities, social science and arts electives, and two free electives. Eight courses provide an engineering foundation. Twelve courses fulfill the degree concentration requirements. Within the concentration requirement, there are five required core courses (CEE 1, 12, 22, 32, and 42), three concentration electives, three design electives, and a capstone design course (CEE 81). The three design electives are selected from at least two sub-disciplines: structural engineering, water resources engineering, environmental engineering and geotechnical engineering. An example sequence of courses for the B.S.C.E. degree is provided below.

**Freshman Year**

**FALL TERM**
- ES 93 First Year Engineering Elective
- MATH 32 Calculus I
- PHY 11 General Physics I
- ENG 1 Expository Writing

**SPRING TERM**
- ES 2 Intro. to Computing in Engineering
- MATH 36 Applied Calculus II
- CHEM 1 Chemical Fundamentals
- Natural Science Elective

**Sophomore Year**

**FALL TERM**
- ES 5 Intro. to Mechanics: Statics and Dynamics
- ES 18 Computer Aided Design
- MATH 42 Calculus III
- PHY 12 General Physics II or CHEM 2 Chemical Principles
- Humanities/Art/Social Science (HASS) Elective

**SPRING TERM**
- ES 9 Applied Mechanics: Strength of Materials
- CEE 1 Intro. to Civil and Environmental Engineering
- MATH 51 Differential Equations
- Foundation Elective
- HASS Elective

**Junior Year**

**FALL TERM**
- ES 8 Fluid Mechanics
- ES 55 Numerical Methods for Engineers
- CEE 22 Structural Analysis
- CEE 42 Intro. to Geotechnical Engineering
- HASS Elective

**SPRING TERM**
- ES 56 Probability and Statistics
- CEE 12 Hydraulic Engineering
- CEE 32 Environmental Engineering Principles
- Foundation Elective
- Design Elective

**Senior Year**

**FALL TERM**
- EM 51 Engineering Management
- Design Elective
- Concentration Elective
- Concentration Elective
Bachelor of Science in Environmental Engineering
The Bachelor of Science in Environmental Engineering (B.S.E.V.E.) is designed for students who desire focused instruction in environmental engineering, including greater emphasis on chemical and biological principles. The B.S.E.V.E. program emphasizes the development of an in-depth understanding of environmental engineering principles, with applications to water and wastewater treatment, water resources engineering, environmental remediation, air quality control, and public health engineering. The mission of the B.S.E.V.E. program is to provide students with undergraduate educational experiences that serve as a sound basis for professional practice in environmental engineering, as well as the necessary preparation for advanced study at the graduate level.

DEGREE REQUIREMENTS
The B.S.E.V.E. program is accredited by the Engineering Accreditation Commission of ABET (www.abet.org). Following the guidelines of the School of Engineering, a total of thirty-eight course credits are required to fulfill the B.S.E.V.E. degree requirements. Of these thirty-eight course credits, a minimum of 9.5 course credits must be completed in college level math and basic science subjects appropriate to the discipline, and a minimum of 14.5 course credits must be completed in engineering topics, consistent with ABET general and program criteria. Introductory science and engineering requirements account for ten courses, with six humanities, social science and arts electives, and two free electives. Eight courses serve as engineering foundation, including two foundation electives. Twelve courses fulfill the degree concentration requirements. Within the concentration requirement, there are five required core courses (CEE 12, 30, 32, 132 and ES 27), four concentration electives, two design electives, and a capstone design course (CEE 81). The two design electives are selected from CEE 112 (Water Resources Engineering), CEE 133 (Water and Wastewater Plant Design), CEE 136 (Air Pollution Control), and CEE 143 (Site Remediation). An example sequence of courses for the B.S.E.V.E. degree program is provided below.

Freshman Year
FALL TERM
ES 93  First Year Engineering Elective
MATH 32  Calculus I
CHEM 1  Chemical Fundamentals
ENG 1  Expository Writing

SPRING TERM
ES 2  Intro. to Computing in Engineering
MATH 36  Applied Calculus II
CHEM 2  Chemical Principles
PHY 11  General Physics I

Sophomore Year
FALL TERM
ES 5  Intro to Mechanics: Statics and Dynamics
MATH 42  Calculus III
CHEM 31  Physical Chemistry
BIO 13  Cells and Organisms
Humanities/Art/Social Science (HASS) Elective

SPRING TERM
EOS 2  Environmental Geology
MATH 51  Differential Equations
ES 27  Public Health Engineering
In addition to the B.S.C.E. and B.S.E.V.E., the department also offers the following undergraduate degree programs.

**Bachelor of Science in Engineering (BSE)**
The Civil and Environmental Engineering department administers three programs of study that lead to the Bachelor of Science in Engineering (B.S.E.) degree. These programs offer students a curriculum that replaces the engineering concentration and design requirements with focused study in a related discipline.

**Bachelor of Science in Engineering – Program in Architectural Studies**
The B.S.E. program in architectural studies is available for students interested in a professional career in architecture or in the historical, aesthetic, and engineering aspects of buildings and other structures. This program, offered jointly by the Department of Civil and Environmental Engineering and the Department of Art and Art History, provides a solid foundation in both the technical aspects of structural systems and the aesthetic and functional characteristics of buildings from an architectural and art history perspective. The flexibility of the B.S.E. degree allows greater concentrations in both art history and studio courses than would otherwise be possible, while providing a coherent basis for graduate work in architecture or design. The faculty coordinator for this program is Professor Masoud Sanayei. A minimum of thirty-eight course credits is required. For details, see [http://engineering.tufts.edu/cee/undergraduate/majors/bseArchitectural.htm](http://engineering.tufts.edu/cee/undergraduate/majors/bseArchitectural.htm).

**Bachelor of Science in Engineering (B.S.E.) – Program in Environmental Health**
The Bachelor of Science in Engineering (B.S.E.) program in environmental health is offered for students wishing to pursue professional careers at the intersection of public health, health sciences and engineering. Historically, programs in environmental health were established to promote research on the control of infectious disease, the purification of water supplies, and the sanitary disposal of human waste. Today, focal...
points of concern have been broadened to such challenging issues as non-point source environmental pollution; the influence of the built environment on the health of populations; epidemiological aspects of chronic illnesses; occupational health; international aspects of environmental health, particularly in developing nations; risk assessment and risk management. The faculty coordinator for this program is David M. Gute. A minimum of thirty-eight course credits is required. For details, see http://engineering.tufts.edu/CEE/undergraduate/majors/bseEnvironmental.htm.

Bachelor of Science in Engineering – Program: Planned Specific to Area of Interest
This Bachelor of Science in Engineering (B.S.E.) program is intended to allow students broader flexibility to develop a degree program that is specific to their area or areas of interest. In consultation with their faculty advisor, students develop a plan of study that focuses on a specific area or integrates several areas of interest. A minimum of thirty-eight course credits is required. The faculty coordinator for the B.S.E. planned program is Kurt Pennell. For details, see http://engineering.tufts.edu/CEE/undergraduate/majors/bse.htm.

Bachelor of Science in Engineering Science (B.S.E.S.)
The Bachelor of Science in Engineering Science is designed for students seeking a technically based engineering science degree program. The program requires a minimum of 38 credits, which consists of ten introductory courses that cover math and sciences, six humanities credits, and two free electives. Students may then select eight foundation electives in natural sciences, mathematics, and engineering, followed by twelve concentration electives that focus on their interests in engineering and natural sciences. The faculty coordinator for the B.S.E.S. program is Daniele Lantagne. For details, see http://engineering.tufts.edu/CEE/undergraduate/majors/bses.htm.

Bachelor of Science (B.S.)
The Bachelor of Science (B.S.) degree program provides a broad liberal education within the School of Engineering, but a less technical one than any other degree in the School of Engineering. Students working toward this degree normally place a heavier emphasis on the humanities and social sciences than students working in the other programs. This degree program recognizes the unique value of engineering as preprofessional education for business administration, city planning, dentistry, medicine, law, and other professions, as well as for the student who wishes to combine engineering with other disciplines. Faculty from the Department of Civil and Environmental Engineering will supervise, with consent, programs of study. This program requires a minimum of 36 course credits. For details see: http://engineering.tufts.edu/CEE/undergraduate/majors/bs.htm.

UNDERGRADUATE MINOR PROGRAMS
Architectural Engineering Minor
The Department of Civil and Environmental Engineering offers a minor in Architectural Engineering for students in the College of Liberal Arts. This minor provides curricular recognition for the technological track in Architectural Studies (see Architectural Studies section). The faculty advisor for this minor is Professor Masoud Sanayei. The Liberal Arts faculty contact is Associate Professor Daniel Abramson.

Foundation courses (three required):
ES 5 Intro to Mechanics: Statics and Dynamics
ES 9 Applied Mechanics: Strength of Materials
ES 18 Computer Aided Design

Elective courses (select two):
ES 2 Intro. to Computing in Engineering
ES 93 First Year Engineering Elective (approved by advisor)
CEE 1 Intro. to Civil and Environmental Engineering
CEE 22 Structural Analysis
CEE 120 The Art of Building

Architectural Studies Minor
The Department of Art and Art History offers a minor in architectural studies that is open to students from both the School of Engineering and the College of Liberal Arts. For details, see full description under Architectural Studies. The faculty advisor for this minor is Associate Professor Daniel Abramson. The Engineering contact faculty is Professor Masoud Sanayei.
Geoengineering Minor
The Department of Civil and Environmental Engineering offers a geoengineering minor that is available to all non-CEE majors. The faculty advisor for this minor is Professor Laurie Baise.

Foundation courses (five required):
- ES 5 Intro. to Mechanics: Statics and Dynamics
- ES 9 Applied Mechanics: Strength of Materials
- CEE 12 Hydraulic Engineering
- CEE 42 Intro. to Geotechnical Engineering

Elective course (select one):
- CEE 112 Hydrology and Water Resource Engineering
- CEE 113 Groundwater Hydrology
- CEE 146 Foundation Engineering
- CEE 149 Earth Support Systems

Prerequisites for the above courses are MATH 36 and PHY 12.

Geology Minor
The Department of Earth and Ocean Sciences offers a minor in geology available to students in the School of Engineering. For details, see the Department of Earth and Ocean Sciences section. The faculty advisor for this minor is Professor Anne Gardulski. The Engineering contact faculty is Professor Laurie Baise.

GRADUATE PROGRAMS
Doctor of Philosophy (Ph.D.)
Students entering the doctoral program in Civil and Environmental Engineering should meet the admission requirements of the graduate school, gain acceptance by the Civil and Environmental Engineering faculty, and hold a Master of Science or Bachelor of Science degree in Civil and Environmental Engineering or a related discipline. The Ph.D. is a research-oriented degree that requires in-depth knowledge of a specific topic of study. Programs of study are highly individualized, but consist of two main components: course work and independent research.

The outcomes for the Ph.D. graduate program are: (1) an in-depth technical knowledge related to one of the subdisciplines within Civil and Environmental Engineering (Environmental Health, Environmental Engineering and Water Resources, Geosystems Engineering, or Structural Engineering and Mechanics); (2) an ability to conduct independent research on a topic in Civil and Environmental Engineering; (3) a scholarly contribution in the field of study with a demonstrated record of scholarship; and (4) communication of results of research activity both orally and in writing.

PROGRAM OF STUDY
Students are required to complete the equivalent of a three-year program of full-time graduate study for the doctoral degree. In general, the first two years of the Ph.D. program will be devoted to course work; a minimum of fifteen courses beyond the baccalaureate level must be completed. Students who enter the program with a Master of Science degree may complete a reduced course load, depending on the master’s degree field of study.

QUALIFYING EXAMINATION
For admission to doctoral candidacy, a Ph.D. student must successfully complete a qualifying examination. Typically, this examination is taken after the student has completed the major part of their required course work, preferably within eighteen months of matriculation. The qualifying examination is administered by faculty members in the student’s subdiscipline area and consists of written and oral components. The qualifying examination is designed to evaluate the student’s overall knowledge of their discipline based on their program of study, and their ability to interpret and critique relevant research concepts and formulate responses to both fundamental and applied problems.

DISSERTATION
The final requirement for the doctorate degree is a dissertation. The dissertation demonstrates the candidate’s ability to perform independent research of high quality and conveys expertise in relevant research tech-
niques and methodologies. The Ph.D. candidate must prepare a written dissertation proposal that describes their research topic in detail, including, but not limited to, a justification, objectives and hypotheses, methods, anticipated results, and schedule. The dissertation research proposal must be presented to and approved by a dissertation committee that consists of the student’s faculty research advisor and at least three additional faculty members with relevant expertise. At least one member of the committee must be from outside the department, and one member must be from outside Tufts University. It is also required that the majority of the committee members be graduate faculty (full-time faculty holding a doctoral degree). The dissertation committee evaluates the research proposal based on technical merits and potential contributions to the field of Civil and Environmental Engineering, and the ability of the student to successfully complete the proposed research. Upon completion of the approved research, scholarly competence is demonstrated through the preparation of a written dissertation of the research. The doctoral candidate must orally defend the content and conclusions of the dissertation in an open forum before the dissertation committee.

For more information, please refer to the CEE website: [http://engineering.tufts.edu/cee/graduate/phd.htm](http://engineering.tufts.edu/cee/graduate/phd.htm).

Master of Science (M.S.)

Instruction leading to the Master of Science degree is offered with concentrations in environmental and water resources, environmental health, geosystems, and structural engineering and mechanics. Candidates for the master’s degree program in environmental and water resources engineering, geosystems engineering, and structural engineering and mechanics are expected to have an adequate background in science, mathematics, and engineering science. Candidates for the master’s program in environmental health should have a background that emphasizes natural and applied sciences with adequate preparation in mathematics, biology and chemistry. The School of Engineering requires that graduate applicants submit Graduate Record Examination (GRE) scores.

Students who lack adequate undergraduate preparation in a related field, such as biology for environmental engineering, mathematics for structural engineering, or fluid mechanics for water resources engineering, may be required to take such course work in addition to their graduate program of study.

A written thesis is required for the M.S. degree program, and two of the ten required courses may be taken as master’s thesis research. Students are expected to form a thesis committee and present a thesis proposal to their committee within twelve (12) months of entering the M.S. program. The thesis committee should be composed of at least three members, with the chair being the student’s advisor within the Department. One of the committee members may be from outside the Department of Civil and Environmental Engineering. As part of the degree program, the master’s candidate must complete a written thesis, which must be defended orally and approved by the committee.

The outcomes for the M.S. graduate program are (1) an ability to apply knowledge of technical skills when working in one of the Civil and Environmental Engineering tracks (Environmental Health, Environmental Engineering and Water Resources, Geosystems Engineering, and Structural Engineering and Mechanics); (2) an ability to conduct and assess research, with mentorship, related to topics in a sub-discipline of Civil and Environmental Engineering; (3) written and verbal communication of research and technical results.

For more information, please refer to the CEE website: [http://engineering.tufts.edu/cee/graduate/ms.htm](http://engineering.tufts.edu/cee/graduate/ms.htm).

Master of Engineering (M.Eng.)

The Master of Engineering program provides a practice-oriented alternative to the Master of Science programs offered by the Department of Civil and Environmental Engineering. It responds to the need to provide engineering students with advanced-level expertise in a civil and environmental engineering specialty, some technical breadth in a related specialty, and familiarity with engineering tools used by the profession. The program is designed for individuals who desire to pursue a career in engineering practice within the private or public sector. We strongly encourage continuing education by engineering practitioners on a part-time basis. The program provides substantial technical depth beyond the bachelor’s degree.

The outcomes for the M.Eng. graduate program are (1) an ability to apply knowledge of technical skills when working in one of the Civil and Environmental Engineering tracks (Environmental Health, Environmental Engineering and Water Resources, Geosystems Engineering, and Structural Engineering and Mechanics); (2) an ability to use both engineering tools and management tools acquired during M.Eng. study when practicing in Civil and Environmental Engineering; (3) engagement in life-long learning related to the technical discipline.
Interdisciplinary Programs

Water: Systems, Science and Society (WSSS)
The Water: Systems, Science and Society (WSSS) graduate program was established to provide the interdisciplinary perspectives and tools to manage water related problems throughout the world. Students participating in the WSSS program must enroll in and fulfill the requirements of a graduate degree within one of the participating schools to ensure a strong knowledge base in their chosen field. WSSS students take courses in three of four core areas and participate in cross-cutting seminars. Students in the research track work on interdisciplinary, problem-focused projects in one of six research areas. Students in the practicum track complete a professional interdisciplinary experience and participate in a special WSSS research practicum.

The WSSS requirements are completed in addition to the student’s degree requirements, but through the use of electives and co-listed courses, the WSSS program usually will not add significant time to a graduate degree program. Upon satisfactory completion of these activities, students receive a Certificate in Water: Systems, Science, and Society as well as their graduate degree. Details of the program are available at the WSSS website: http://www.tufts.edu/water/about.html.

Bioengineering (M.S. and M.Eng.)
The Bioengineering program provides a broad engineering and biotechnology curriculum, while offering a focus on a specific engineering track that best fits students’ interests and career objectives. The bioengineering master’s program has six tracks: Bioinformatics, Biomaterials, Biomechanical Systems and Devices, Cell and Bioprocess Engineering, Environmental Biotechnology, and Signals and Systems.

The bioengineering master’s program has two components: an interdisciplinary core curriculum, including one class outside of students’ chosen sub-specialty to increase the breadth of bioengineering knowledge, and courses required by the student’s home department for each chosen track. The majority of students in CEE will select the Environmental Biotechnology track. Additional information on this program is provided on the School of Engineering website: http://engineering.tufts.edu/bme.

For graduate students who are interested in Urban and Environmental Policy, the Department of Civil and Environmental Engineering participates in a joint degree program offered in association with the Department of Urban and Environmental Policy and Planning.

Continuing Education Programs

Post-Baccalaureate in Civil and Environmental Engineering

The post-baccalaureate (post-bac) program is intended for academically talented, highly motivated students, with at least a bachelor of science or bachelor of arts degree (B.S. or B.A.) in disciplines with relevant mathematics and science content. The 1-year program is designed to prepare students for graduate study in Civil and Environmental Engineering. Accepted students develop an individualized plan of study based on their academic background and goals. A total of five Tufts courses are required to complete the program.

Core Engineering requirement:
ES 5 Intro. to Mechanics: Statics and Dynamics

Foundation elective (select one):
ES 8 Fluid Mechanics
ES 9 Applied Mechanics: Strength of Materials

Concentration Elective (select one):
CEE 12 Hydraulic Engineering
CEE 22 Structural Analysis
CEE 32 Environmental Engineering Principles
CEE 42 Intro. to Geotechnical Engineering

Elective courses (select two in consultation with your advisor)

Students in the post-bac program must satisfy all course prerequisites listed on Tufts Bulletin. Courses numbered above 100 can be used for graduate credit, and are transferable into the Tufts graduate program. Completion of the post-bac program does not guarantee admission into the graduate program. Students may take ES 5 and/or ES 9 during the summer session. Please see the Tufts Summer Session for more information: http://ase.tufts.edu/summer.
Certificate Program in Environmental Management

A five-course graduate-level certificate program in Environmental Management is designed for students with a bachelor’s degree and at least two years of work experience. Additionally, students should have some knowledge of current environmental issues and should have undergraduate coursework in natural or physical science, mathematics, or engineering. The certificate programs can be completed on a part-time, non-degree basis by students who are seeking professional training in the field or are preparing for a degree program. In most cases, courses taken as a certificate student can be transferred into a related master’s degree program in the Department of Civil and Environmental Engineering.

Certificate students must complete five graduate course credits from the clusters listed below. Students must take at least one course from each concentration area listed below. The remaining two courses for the certificate can be selected from any of the areas.

Environmental Technology
CEE 113 Groundwater Hydrology
CEE 136 Air Pollution Control
CEE 138 Hazardous Waste Treatment
CEE 139 Bioremediation
CEE 143 Site Remediation
CEE 172 Fate and Transport of Environmental Contaminants

Environmental Law, Management, and Policy
CEE 185 Environmental Law, Management, and Policy
CEE 187 Geographic Information Systems (GIS)
CEE 207 Environmental Law
CEE 265 Corporate Management of Environmental Issues
CEE 267 Methods in Environmental Impact Assessment

Health, Safety, and the Environment
CEE 154 Principles of Epidemiology
CEE 158 Occupational and Environmental Health
CEE 164 Epidemiological Methods
CEE 167 Environmental Toxicology
CEE 168 Exposure Assessment
CEE 173 Health Effects and Risk Assessment
CEE 175 Hazardous Materials Safety
CEE 194 Field Methods for Global Health
CEE/MPH 241 Biology of Water and Health
MPH 205 Biostatistics

Students may take other courses to fulfill the track requirements with permission of the program advisor, Lecturer Anne Marie C. Desmarais. For more detailed information, please refer to the CEE website http://engineering.tufts.edu/cee/graduate.

Certificate Program in Epidemiology

Offered in collaboration with Tufts’ School of Medicine, the Friedman School of Nutrition Science and Policy, and the Department of Civil and Environmental Engineering, this interdisciplinary program is designed to help students understand, integrate, and apply epidemiologic methods and research. The program is especially appropriate for clinicians, professionals in public health and human service agencies, lawyers, industrial hygienists, pharmaceutical or biotechnology professionals, environmental engineers or scientists, and individuals involved in citizen activist groups focusing on human health issues. It’s also useful for individuals who are considering a career in epidemiology and/or public health but are not yet ready to commit to a full master’s degree program. Open to individuals with a bachelor’s degree, the certificate requires the completion of five courses as follows:

Foundation courses (two):
CEE 154 Principles of Epidemiology
CEE 164 Epidemiologic Methods
Biostatistics (select one, may be exempted by prior coursework):

BIO 132 Biostatistics
MPH 205 Principles of Biostatistics
MPH 259 Fundamentals of Biostatistics

Elective courses (select two in your area of interest or expertise); examples include:

MPH 204 Occupational and Environmental Health
MPH 220 Cardiovascular Epidemiology
MPH 222 Survey Research Methods and Data Management
MPH 224 Infectious Disease Epidemiology
MPH 226 Cancer Epidemiology
MPH 240 Environmental Epidemiology
CEE 137 Public Health
CEE 158 Occupational and Environmental Health
CEE 167 Environmental Toxicology
CEE 173 Health Effects and Risk Assessment
CEE/MPH 241 Biology of Water and Health
UEP 281 Toxic Chemicals and Human Ecology

Other courses may be selected with the approval of the Program Advisor, Senior Lecturer Mark A. Woodin. An optional internship is available to students desiring a professional experience in the use of epidemiology. The internship would count as an elective and be started after all other coursework is completed. For more information, please visit the Epidemiology Graduate Certificate program website:

The Department of Classics is dedicated to the study of Greek and Roman culture and to clarifying and assessing its continuing impact on contemporary life. Classics is more than the study of the Greek and Latin languages; it can liberate the student from the parochialisms of both time and place. The role of the contemporary individual in relation to society can be examined through the history, archaeology, art, architecture, science, philosophy, religion, mythology, and especially the literatures of Greece and Rome.

Classics constitutes an interdisciplinary study of the cultures of the ancient Mediterranean, Near East, and Europe. Despite the period of antiquity in which it concentrates, the field of classics is constantly changing in light of new discoveries, new methodologies, new interpretations, and new relationships with other areas of study. In many ways, classics offers the undergraduate student an ideal educational opportunity to integrate different fields and methodologies, and to study intrinsically interesting and time-tested topics in the literature, mythology, art, archaeology, history, and science of Greece and Rome.

UNDERGRADUATE CONCENTRATION REQUIREMENTS
Majors in the Department of Classics meet the requirements of four classes of students:
1) those who have no professional interest in classics but who wish to bring together disparate distribution and foundation requirements for a coherent liberal arts major;
2) those who want a combined major in Latin, Greek, or Classical Studies and one of the natural sciences, social sciences, or humanities;
3) those who want an intensive study of Greek or Latin preparatory to postgraduate study in another field, such as law, theology, medicine, philosophy, history, English, or modern languages;
4) those who are professionally interested in the classics and who plan to do postgraduate study in the field and then teach or engage in research or museum work.

Major in Classical Studies
Ten courses are required, usually distributed as follows:
a. CLS 31 or GRK 131; CLS 32 or LAT 132
b. CLS 37 and 38, or two in Greek and Roman archaeology (CLS 27, 164, 168)
c. Two more classes in CLS, LAT, GRK numbered above 100 in addition to any taken in fulfillment of (a) and (b)
d. Four other courses, of which at least two must be in CLS, LAT (3 or above), or GRK (any level) and at most two may be in SKT (any level) or related fields. Latin and Greek language courses are strongly recommended.
Major in Greek
Ten courses:
  a. CLS 31 or GRK 131
  b. CLS 37
  c. Four courses in Greek, one of which may be GRK 3, at least 3 at 100-level; not including GRK 131 if taken in place of CLS 31, but if a student takes both CLS 31 and GRK 131, then GRK 131 can be counted here
  d. Four other courses in CLS, GRK, LAT, SKT, at least 2 at 100-level

Major in Latin
Ten courses:
  a. CLS 32 or LAT 132
  b. CLS 38
  c. Five courses in Latin above Latin 3, at least 3 at 100-level; not including LAT 132 if taken in place of CLS 32, but if a student takes both CLS 32 and LAT 132, then LAT 132 can be counted here
  d. Three other courses in CLS, LAT, GRK, SKT, at least 2 at 100-level

Major in Greek and Latin
Ten courses: six courses in Greek and Latin above the intermediate level, of which four must be at the 100 level; four other courses offered by the department.

Interdisciplinary Major in Archaeology
A detailed description of this major can be found in the alphabetical listings in this bulletin under Archaeology.

PLACEMENT FOR ENTERING UNDERGRADUATE STUDENTS
Students with two years of secondary school preparation in Latin are usually placed in Latin 3. Students with three or four years of preparation in Latin are usually placed in Latin 3, or 21, 22, depending on CEEB examination or previous records, together with placement examination and individual consultation. In Latin as in other languages, the student is urged not to prejudge his or her college courses on the basis of secondary school experience. Students who place above Latin 3 may complete the language requirement in any one of the three available options, including classical studies (see information concerning foundation requirements). Students with scores of four or five on the Advanced Placement Examination or with an Achievement Test score of 720 or above will be given advanced placement into Latin 21 or above and acceleration credit of one course. With a score of three, students will be placed into Latin 21 or above; with a score of two, into Latin 3. During orientation every student is encouraged to discuss any unusual placement problem with members of the department so that in every case the student is placed in the appropriate course.

Students who complete or place out of Latin 3 have completed part I of the foundation language requirement. To complete part II in Latin a student must take Latin 21 and 22, in either order; there is no Latin 4 course.

Students with two years of secondary school preparation in ancient Greek are normally placed into Greek 2 or Greek 7. Students with three or four years of preparation in ancient Greek are normally placed in Greek 7 or above, depending on previous records, together with placement examination and individual consultation. In ancient Greek, as in other languages, the student is urged not to prejudge his or her college courses on the basis of secondary school experience.

Students who complete or place out of Greek 3 have completed part I of the foundation language requirement. To complete part II in Greek a student must take two more courses, one of which may be Greek 22.

UNDERGRADUATE MINOR PROGRAM
The Department of Classics offers minors in Latin, Greek, Greek archaeology, Roman archaeology, Greek civilization, and Roman civilization. Details are available from the departmental office.

GRADUATE PROGRAM
Master of Arts in Classics
The master’s program in classics at Tufts is designed for students who wish to go beyond the bachelor’s level to attain a broader and deeper knowledge of the classics for one or more of the following purposes: teaching, further graduate study, digital technology, or publishing. With its strong language component and
faculty strength in literature, history, archaeology, and digital humanities, this program particularly suits those who want either to consolidate and improve their language, research, and teaching skills in preparation for a Ph.D. degree at another institution or to teach classics at the secondary level.

**REQUIREMENTS**
Candidates must successfully complete ten graduate courses in Classics. Two must be in upper-level Latin and two must be in upper-level Greek; one must be in history; and one must be in classical archaeology. Candidates will usually have completed the equivalent of an undergraduate Latin or Greek major. If not, additional courses will be required for completion of the master’s degree.

Reading knowledge of Latin or Greek and one modern foreign language (usually German or French) is tested by examination.

To demonstrate research and presentation, the candidate may submit for evaluation by a Classics faculty committee either two qualifying papers (written for courses at Tufts and revised as necessary after completion of the course) or a thesis. The thesis normally counts as two of the required ten courses. Students usually find that writing a thesis takes a full term of uninterrupted work. An oral examination based on the qualifying papers or thesis is required.

A comprehensive written examination integrating course work with knowledge of the reading lists in Greek and Latin literature is required.

**Master of Arts in Classics with Initial Teacher Licensure in Latin and Classical Humanities**
The master’s program in classics with licensure allows students to pursue intensive study of the classical world beyond the bachelor’s level and simultaneously to acquire the credentials for a professional teaching career in public education. Students in this program have an opportunity to study literature, history, archaeology, and digital humanities in the Classics Department. Concurrently they prepare for a career in teaching (grades 5-12) through coursework and supervised teaching offered by the Education Department at Tufts. In strengthening their language, research, and teaching skills, graduates are also prepared to pursue a Ph.D. degree at another institution.

**REQUIREMENTS**
Candidates must successfully complete six graduate courses in Classics. Two must be in upper-level Latin and two must be in upper-level Greek. Candidates will usually have completed the equivalent of an undergraduate Latin or Greek major. If not, additional courses will be required for completion of the master’s degree.

Candidates must successfully complete seven graduate courses in Education: one at the introductory level; one in human development and learning; one in the social, cultural, and historical foundations of education; one in exceptionalities in learning; two courses in second language instruction with an emphasis in Latin and Greek; and one in supervised teaching worth two credits.

Reading knowledge of Latin or Greek and one modern foreign language (usually German or French) is tested by examination.

To demonstrate research and presentation, the candidate may submit for evaluation by a Classics faculty committee either two qualifying papers (written for courses at Tufts and revised as necessary after completion of the course) or a thesis. The thesis normally counts as two of the required six courses. Students usually find that writing a thesis takes a full term of uninterrupted work. An oral examination based on the qualifying papers or thesis is required.

A comprehensive written examination integrating course work with knowledge of the reading lists in Greek and Latin literature is required.

**Master of Arts in Classical Archaeology**
The master’s program in classical archaeology at Tufts is designed to provide students with the material-cultural, social, historical, and artistic contexts needed to interpret the material remains of classical antiquity in preparation for further graduate study, for professional field archaeology, or for museum work. In combination with faculty strength in literature and ancient history, this program particularly suits those who want to consolidate and improve their language and research skills in preparation for a Ph.D. degree at another institution.

**REQUIREMENTS**
Candidates must successfully complete ten graduate courses in Classical Archaeology and related fields. Four must be in classical archaeology; three must be in upper-level Latin and/or in upper-level Greek; and
one must be in ancient history. Candidates will usually have completed the equivalent of an undergraduate major in Classics, Ancient Art, or Archaeology and have attained intermediate levels in both Latin and Greek. If not, additional courses will be required for completion of the master’s degree.

Both fieldwork and laboratory work are requirements, either as documented past experience or to be fulfilled during completion of the master’s degree.

Reading knowledge of Latin or Greek and one modern foreign language (usually German or French) is tested by examination.

To demonstrate research and presentation skills, the candidate may submit for evaluation by a faculty committee either two qualifying papers (written for courses at Tufts and revised as necessary after completion of the course) or a thesis. The thesis normally counts as two of the required ten courses. Students usually find that writing a thesis takes a full term of uninterrupted work. An oral examination based on the qualifying papers or thesis is required.

A comprehensive written examination integrating course work with a general knowledge of classical archaeology and of the reading lists in Greek and Latin literature is required.

For more detailed information, please visit the website http://asc.tufts.edu/classics.
Clinical Psychology

(for degree requirements, see psychology.)
Cognitive and Brain Sciences

(FOR DEGREE REQUIREMENTS, SEE PSYCHOLOGY.)
A joint Ph.D. in Cognitive Sciences is offered through the departments of Child Development, Computer Science and Psychology. Prospective students apply to one of the departments participating in the cognitive science Ph.D. program and indicate in their application their intention to apply to the joint program. Once admitted to the program, students will have to complete the Ph.D. requirements of their home department as well as those of the Cognitive Science program, and their research will have to be in the intersection of a field in their home department and cognitive science.

For further information, see http://cogsci.tufts.edu or contact Matthias Scheutz <matthias.scheutz@tufts.edu> for Computer Science/Cognitive Science, Gina Kuperberg (gina.kuperberg@tufts.edu) for Psychology/Cognitive Science, or Maryanne Wolf (maryanne.wolf@tufts.edu) for Child Development/Cognitive Science.

(FOR MAJOR IN COGNITIVE AND BRAIN SCIENCES, SEE PSYCHOLOGY.)

(FOR MINOR IN COGNITIVE AND BRAIN SCIENCES, SEE PHILOSOPHY.)
Colonialism Studies

Director:
Professor Lisa Lowe English

Executive Board:
Associate Professor Kris Manjapra, History
Associate Professor Kamran Rastegar, German, Russian, and Asian Languages and Literatures

Advisory Faculty:
Professor Brian Hatcher, Religion
Professor H. Adlai Murdoch, Romance Languages
Associate Professor Amahl Bishara, Anthropology
Associate Professor Pearl Robinson, Political Science
Associate Professor Adriana Zavala, Art History

Colonialism Studies is a program in the Consortium of Studies in Race, Colonialism and Diaspora. The Colonialism Studies minor is designed to offer students a strong foundation to understand processes of colonialism, anti-colonial independence movements, and the national and global effects of colonialism. Students explore the historical and present-day colonial formations. This course of study connects the differentiated concerns of slavery, military colonialism, war, processes of extraction and accumulation, cultural imperialism, gendered and sexual violence. Students consider problems and contexts that are specific to the Americas, Africa, Europe and Asia, and ones that cross and bind together world regions. Colonialism Studies exposes the meaningful links among multiple sites, communities, and subjects where colonialisms have forcibly shaped and remade terrains of rule, diaspora, struggle, contestation, and cultural expression.

The minor requires five courses: one introductory survey course (see the course listing on the Colonialism Studies website); two courses with a full or partial focus on the processes of colonialism, focusing on the same world region or on the comparison between two or more world regions; one additional course that contributes to the analytical understanding of power relations through political, economic, gender-based, historical, or cultural analysis; and a senior capstone project or option course.

The senior capstone project is an independent study culminating in an original piece of work intended to draw together a student’s experience at Tufts. The project should reflect an understanding of the conceptual approaches explored during the completion of the minor. The capstone project will be evaluated by two members of the Colonialism Studies committee.

As an alternative to the senior capstone project, a student has the option of taking an approved Colonialism Studies Course during the first or second semester of senior year, and fulfilling the capstone requirement by writing a research paper (minimum 15 pages), or completing an oral presentation or a performance, which integrates the knowledge and methodologies from the course with other conceptual approaches explored in courses taken for the minor. In the case of the option course, the capstone project will be evaluated by the course instructor and one other member of the Colonialism Studies committee.

The choice of capstone or option course must be approved by the Colonialism Studies committee before it begins.

In completing the above requirements, students must select courses distributed across at least three departments/programs.

Students in the minor are strongly recommended to pursue the study of a foreign language to an advanced level.

Students interested in pursuing a Colonialism Studies Minor should register with Cynthia Sanders, Program Administrator, 110 Eaton Hall, 617-627-2311, Cynthia.Sanders@tufts.edu

For more detailed information, please visit the website http://as.tufts.edu/ColonialismStudies/
Communications

(SEE FILM AND MEDIA STUDIES.)
Community Environmental Studies

FACULTY ADVISOR: Barbara Parmenter, Urban and Environmental Policy and Planning

Environmentalists and concerned citizens alike face the challenge of keeping pace with politically and technically complex issues. The considerable sophistication of the environmental movement constantly creates new challenges for conservation and preservation, environmental justice, and safety and health in the workplace and community.

The certificate in Community Environmental Studies (CES) provides professional training for careers in today’s rapidly evolving environmental field. CES’s interdisciplinary curriculum is designed to clarify career goals for those who may be considering environmental work, and to enhance the skills of professionals already in the field. The certificate is offered by the graduate Department of Urban and Environmental Policy and Planning.

The certificate requires the completion of four courses—one core and three electives—in such varied subjects as environmental policy, land use planning, sustainability, mediation, law and economics.

The program is open to individuals with a bachelor’s degree and is especially suited to those in community and environmental organizations who want to increase their expertise; midcareer professionals who want to apply their skills to environmental concerns; and business people working with communities on issues relating to sustainability, the environment and public health.

For more information, contact the Program Administrator, Angela Foss, at 617-627-2320, or visit http://as.tufts.edu/uep/programs/certificate.
Community Health

DIRECTOR:
Jennifer Allen, Professor of Community Health

FACULTY AND ADVISORY BOARD:
Andrea Acevedo, Assistant Professor, Community Health
Carol Baffi-Dugan, Associate Dean of Undergraduate Education, Director for Health Professions Advising
Harry Bernheim, Associate Professor of Human Physiology and Immunology
Jonathan Garlick, Professor of Oral Pathology, Tufts University School of Dental Medicine
David Gute, Associate Professor, Department of Civil and Environmental Engineering
Rosemary C.R. Taylor, Associate Professor of Sociology
Karen Kosinski, Lecturer, Community Health
Keren Ladin, Assistant Professor, Community Health and Occupational Therapy
Alecia McGregor, Assistant Professor, Community Health
Fernando Ona, Assistant Professor, Public Health and Community Medicine
Carolyn Rubin, Assistant Professor, Public Health and Community Medicine
Mark Woodin, Senior Lecturer, Department of Civil and Environmental Engineering
Shalini A. Tendulkar, Lecturer, Community Health
Pamela Schoenberg Reider, Program Administrator, Internship Coordinator

Community Health (sometimes called Public Health) is an interdisciplinary field focused on the prevention of disease, promotion of health, and prolongation of life among communities and/or populations as a whole. Community health actions, programs and policies aim to provide conditions in which people can be healthy. In addition, Community Health is focused on the elimination of inequities in health status across communities and/or populations. Community Health spans diverse aspects of health and society and encourages students to explore health issues from a variety of disciplinary perspectives, including, but not limited to: anthropology, sociology, biology, psychology, history, economics, engineering, nutrition, philosophy, classics and political science. Through courses and fieldwork, Community Health students analyze: (1) social, economic, political and environmental factors that influence health and illness, (2) how communities define and develop solutions to address priority health issues, (3) the formation of health care policy in the United States with a comparative look at other countries, and (4) the institutions that plan, regulate, and deliver health care services and public health programs.

CORE REQUIREMENTS FOR THE MAJOR
To complete a major in Community Health, students must take a total of twelve courses. In addition to a broad academic experience, students complete a 150-hour internship for which they receive one academic credit. There are seven required courses and students may select five approved electives.

REQUIRED COURSES
1. Introduction to Community Health (CH 1) *
2. Health care in America: Policies and Politics (CH 2)
3. Introduction to Global Health (CH 56) or approved equivalent
4. Community Health Research Methods (CH 30) or approved equivalent
5. Principles of Epidemiology (CE/CH 154)
6. Introduction to Statistics (CH 31) or approved equivalent
7. Community Health Internship (CH 180)***

* It is STRONGLY recommended that students take CH 1 as their first Community Health course.

***Students must complete prerequisites. See Course Requirements at CHP. Note: the internship may only be completed by second semester juniors or seniors.

ELECTIVE COURSES FOR PRIMARY MAJOR
- Community Health majors are required to select and complete five electives as follows:
  - One mid-level or upper-level CH elective
  - One upper-level CH elective
• Two CH or approved electives in another Department or Program
• One upper-level approved elective with a research component

Information about mid- and upper-level courses, as well as approved electives and research courses are available on the Community Health website (http://ase.tufts.edu/commhealth) or from the Community Health office (see below for contact information).

EXPERIENTIAL LEARNING: INTERNSHIP (CH 180)
The internship is an integral part of the Community Health Program and is required for both primary and secondary majors. For many students, the 150-hour internship proves to be one of the most valuable learning experiences in the program, establishing a link between theory and practice. The Community Health Program provides assistance to students in finding an internship, and students have considerable latitude in selecting a placement. Placements have included community health centers, local hospitals, schools, social service agencies, advocacy organizations, government offices, or shelters. Area placements have included sites such as the Boston Center for Refugee Health and Human Rights, the Boston Childhood Lead Poisoning Prevention Program, the Dana-Farber Cancer Institute, the Massachusetts Coalition for Occupational Safety and Health, the Children’s Hospital Young Parents Program, the AIDS Action Committee, offices at the State House, the Haitian Coalition, and the Mystic River Watershed Association. Students are required to do their internships in the Greater Boston Area so that the Community Health Internship Coordinator and assigned faculty member can be in close contact with the internship Site Supervisor. To receive academic credit, a grade of B- or better is required for the internship.

PROGRAM POLICIES
Pass/Fail: No course submitted for credit in the major can be taken on a pass/fail basis.
Academic Standing: All courses submitted for credit in the major must have a grade of C- or better, with the exception of the internship. Students must pass the internship (CH 180) with a grade of B- or better.
Courses taken at Other Institutions: Students may petition courses taken abroad for major credit, but no more than three courses taken at other institutions may count toward the major. Students may petition a course to count for major credit when they have a course syllabus, which is typically after they return. This process is a separate one from that of transferring the credit to Tufts, which students do through the online system. The CH Transfer of Credit representative will advise them on what will likely count for CH credit. See the CH website for more information.

More information may be obtained from the program office at 574 Boston Avenue, Suite 208, by calling 617-627-3233, or by e-mail (chp@tufts.edu). Visit our website at http://ase.tufts.edu/commhealth.
Computer Engineering

(FOR DEGREE REQUIREMENTS, SEE ELECTRICAL AND COMPUTER ENGINEERING.)
Professor Kathleen Fisher, Chair; Programming languages
Professor Lenore J. Cowen, Computational biology, theory of computation, algorithm design and analysis
Professor J. P. De Ruiter, Cognitive foundations of communication
Professor Robert J. K. Jacob, Human-computer interaction
Professor Soha Hassoun, Computational systems biology, computer-aided design for integrated circuits
Professor Roni Khardon, Machine learning, artificial intelligence, computational learning theory
Professor Matthias Scheutz, Artificial intelligence, cognitive science, human-robot interaction
Professor Donna Slonim, Computational biology
Professor Diane L. Souvaine, Senior advisor to the provost; Computational geometry, algorithm design and analysis
Associate Professor Remco Chang, Visualization, visual analytics, computer graphics
Associate Professor Anselm C. Blumer, Artificial intelligence, machine learning, computational biology
Associate Professor Alva Couch, Network and system administration, scientific computing and visualization
Associate Professor Samuel Z. Guyer, Compilers, programming languages
Associate Professor Norman Ramsey, Programming languages and systems, functional programming
Assistant Professor Fahad Dogar, Networking, distributed systems, mobile computing, cloud computing
Assistant Professor Benjamin Hescott, Computational complexity, approximation and parallel algorithms, computational biology
Senior Lecturer Ming Chow, Computer games, computer security and privacy
Lecturer Bruce Molay, Specializes in teaching the introductory sequence of Computer Science
Lecturer Mark Sheldon, Data structures, programming languages, software systems, software design
Lecturer Elena Strange, Parallel and distributed computing, supporting underrepresented groups in Computer Science
Visiting Associate Professor Greg Aloupis, Computational geometry

SECONDARY APPOINTMENTS:
Adjunct Professor Marina Bers, Child Development; Human-computer interaction, collaborative learning systems, virtual communities
Adjunct Professor Bruce Boghosian, Mathematics; Quantum computing, scientific and distributed computing
Adjunct Professor Christoph Börgers, Mathematics; Applied mathematics and computing
Adjunct Professor Gregory Crane, Classics; Ancient Greek literature, computing and its impact on learning
Adjunct Professor Misha Kilmer, Mathematics; Numerical linear algebra, linear algebra, scientific computing and visualization
Adjunct Professor Eric L. Miller, Electrical and Computer Engineering; Signal and image processing
Adjunct Professor Karen Panetta, Electrical and Computer Engineering; Human-computer interaction, multimedia studies
Adjunct Assistant Professor Shuchin Aeron, Electrical and Computer Engineering; Statistical signal processing, network information theory
Research Assistant Professor Ethan Danahy, Center for Engineering Educational Outreach; Technology solutions for engineering education

The department offers undergraduate programs in computer science for both liberal arts and engineering students, M.S. and Ph.D. degree programs, and several non-degree graduate programs. Both the Arts and Sciences and Engineering programs are included in the general accreditation conferred on the University by NEASC. In addition, the Bachelor of Science in Computer Science (B.S.C.S.) program offered through the School of Engineering is accredited by the Computing Accreditation Commission (CAC) of ABET, Inc. (http://www.abet.org).

UNDERGRADUATE CONCENTRATION REQUIREMENTS — COLLEGE OF LIBERAL ARTS
Major in Computer Science
The major in Computer Science requires ten courses: eight courses in computer science and two courses in mathematics. The computer science courses must include Computer Science 15, 40, 80 or 105, 160, and 170 and the remaining courses must be numbered above 15. Only one of Comp 80 or Comp 105 may be counted toward the major. The mathematics courses are Calculus II (which can be taken as Mathematics 34, 36, or 39) and Discrete Mathematics (which can be taken as Mathematics 61 or Computer Science 61). The introducto-
ry courses Computer Science 10 and 11, as well as Mathematics 4, 14, 30, and 32, do not count toward the major. No more than one Directed Study (93, 94, 193, 194) may be counted toward the major. All ten courses to be counted toward the major must be completed with a grade of C- or better. The above are minimal requirements for the concentration. For students who desire a stronger program, the following courses are recommended: Computer Science 97, 98, 111, 181; Mathematics 70, 145, 161 and 162.

For an ABET CAC accredited program, see the B.S.C.S. in the School of Engineering, described below.

UNDERGRADUATE CONCENTRATION REQUIREMENTS — SCHOOL OF ENGINEERING
Bachelor of Science in Computer Science
The mission of the Computer Science in Engineering program is to provide graduates with the durable knowledge necessary to become future leaders in the rapidly evolving discipline of Computer Science as well as in other computer-related fields. We aim to give each graduate a solid foundation in both Computer Science theory and programming practice, and to prepare each graduate for further advanced study in Computer Science and related fields. We aim to expose each graduate to the challenges and research problems involved in creating new kinds of computer software. We aim to give graduates the skills and commitment to lifelong learning necessary to prepare them to be effective employees or graduate students in computer-related fields. The faculty is dedicated to accomplishing this mission through integration of teaching and research. The Bachelor of Science in Computer Science (B.S.C.S.) program offered through the School of Engineering is accredited by the Computing Accreditation Commission (CAC) of ABET, Inc. (www.abet.org).

Our program objectives include success in industry careers and graduate school. Two to five years after graduation, graduates of the B.S.C.S. program will have:
1) succeeded and advanced in professional careers in or related to computing or software.
2) been admitted to and advanced in graduate study in computer science.

Outcomes of the B.S.C.S. program include that:
1) Graduates should be able to use computer science theory to analyze algorithms and to reason about properties of programs, including structure, behavior, and performance.
2) Graduates should be able to solve problems by using principled methods to create, extend, and improve software.
3) Graduates should have had practice applying their knowledge and skills to open-ended problems with more than one good answer.
4) Graduates should have practice working in teams.

Additionally, the B.S.C.S. degree aims to empower our students with ABET Computing Accreditation Commission outcomes a–k, including:

a. An ability to apply knowledge of computing and mathematics appropriate to the discipline.
b. An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.
c. An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.
d. An ability to function effectively on teams to accomplish a common goal.
e. An understanding of professional, ethical, legal, security and social issues and responsibilities.
f. An ability to communicate effectively with a range of audiences.
g. An ability to analyze the local and global impact of computing on individuals, organizations, and society.
h. Recognition of the need for and an ability to engage in continuing professional development.
i. An ability to use current techniques, skills, and tools necessary for computing practice.
j. An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the trade-offs involved in design choices.
k. An ability to apply design and development principles in the construction of software systems of varying complexity.

The Bachelor of Science in Computer Science (B.S.C.S.) requires thirty-eight courses including introductory, foundation, HASS, breadth, and concentration courses. Introductory courses (10 credits) include Engi-
neering Science 93; Engineering Science 2; Math 32, 36, and 42; Computer Science 61 (Mathematics 61 may be substituted for Computer Science 61); Physics 11; Chemistry 1 or 16; Physics 12 or Chemistry 2; and a natural science elective. For natural science courses accepted towards the Engineering degrees, refer to the online course catalog for courses with attribute “Engineering Requirements”, and value “SOE-Natural Sciences”. The foundation requirement (5 courses) includes Computer Science 11 and 15, Engineering Science 3 and 4, and a statistics course chosen from Mathematics 162, Engineering Science 56, Electrical Engineering 24 or 104, Biomedical Engineering 141, Biology 132, Physics 153. The Humanities, Social Sciences, and Arts (HASS) requirement (6 courses) includes English 1 or 3 and five courses in Humanities, Arts, or Social Sciences. Of these five courses, one must be Humanities, one must Social Science, and two must be in the same department. Allowable courses in Humanities, Arts, and Social Sciences are listed in the online course catalog with attribute “Engineering Requirements” and possible values “SOE-HASS-Humanities”, “SOE-HASS-Arts”, and “SOE-HASS-Social Sciences”, respectively. The breadth requirement includes one course in ethics and social context (Philosophy 24 or Engineering Management 54); and three courses chosen either from Humanities, Arts, and Social Sciences, or from selected courses covering the broader context of engineering. A list of selected courses appropriate for the last three credits of the breadth requirement is available from the department. The concentration requirement (11 courses) includes Computer Science 40, 160, 170, 97, 98, and 80 or 105; and five elective courses in computer science, three of which must be numbered above 100. Only one of Computer Science 80 or Computer Science 105 may be counted toward the degree. At most one credit of Independent Study or Research (Computer Science 93, 94, 191, 193, 194) and one credit of thesis (Computer Science 197) may be utilized as concentration electives. Internship credit (Computer Science 99) may not be counted toward the concentration requirement, though one credit of Computer Science 99 may be counted toward the breadth requirement. For a research experience, students should consider partly fulfilling concentration elective requirements via a senior thesis.

At the student’s option, one concentration elective may be replaced by a one-credit course in Mathematics, selected from the following choices:

Math 51 - Differential Equations (formerly MATH 38)
Math 63 - Number Theory (formerly MATH 41)
Math 70 - Linear Algebra (formerly MATH 46)
Math 72 - Abstract Linear Algebra (formerly MATH 54)
Math 87 - Mathematical Modeling and Computation
Math 126 - Numerical Analysis
Math 128 - Numerical Linear Algebra
Math 135 - Real Analysis I
Math 136 - Real Analysis II
Math 145 - Abstract Algebra I
Math 146 - Abstract Algebra II
Math 151 - Applications of Advanced Calculus (cross-listed as Mechanical Engineering 150)
Math 152 - Nonlinear Partial Differential Equations
Math 158 - Complex Variables
Math 161 - Probability
Math 162 - Statistics
Math 163 - Computational Geometry

The following sample program is one way of satisfying the above requirements; further information regarding options and procedures is available from the department.

First Year
FALL TERM
Engineering Science 93
Mathematics 32
Physics 11
English 1

SPRING TERM
Engineering Science 2
Mathematics 34 or 36
Chemistry 1 or 16
Humanities, social sciences, or arts elective
Sophomore Year

FALL TERM

Computer Science 11 Introduction to Computer Science
Mathematics 42
Physics 12 or Chemistry 2
Engineering Science 3 Introduction to Electrical Engineering

Humanities, social sciences, or arts elective

SPRING TERM

Computer Science 15 Data Structures
Computer Science or Mathematics 61 Discrete Mathematics
Engineering Science 4 Introduction to Digital Logic Circuits

Natural science elective
Humanities, social sciences, or arts elective

Junior Year

FALL TERM

Computer Science 40 Machine Structure and Assembly-Language Programming
Computer Science elective
Engineering Management 54 Engineering Leadership

Humanities, social sciences, or arts elective
Free elective

SPRING TERM

Computer Science 160 Algorithms
Computer Science elective
Humanities, social sciences, or arts elective
Breadth elective (humanities, social sciences, arts, or engineering)
Free elective

Senior Year

FALL TERM

Computer Science 97 Senior Capstone Project I
Computer Science 105 Programming Languages
Computer Science elective
Probability & Statistics (Engineering Science 56 or Electrical Engineering 24)
Breadth elective (humanities, social sciences, arts, or engineering)

SPRING TERM

Computer Science 98 Senior Capstone Project II
Computer Science 170 Theory of Computation
Computer Science elective

Breadth elective (humanities, social sciences, arts, or engineering)

UNDERGRADUATE MINOR PROGRAM

Minor in Computer Science
The undergraduate minor in Computer Science consists of five courses, including Computer Science 15; two courses chosen from Computer Science 40, 105, 160, and 170; Computer Science/Mathematics 61; and one additional course in computer science numbered above 15. Only one of Computer Science 80 or 105 may be counted toward the minor. All such courses to be counted toward the minor must be completed with a grade of C- or better.

POST-BACCALAUREATE PROGRAM IN COMPUTER SCIENCE
The post-baccalaureate program in Computer Science offers the student with a bachelor’s degree, but few computer science courses, the opportunity to earn the equivalent of an undergraduate minor in computer science by completing the requirements for the minor. It is designed to give the student with a nontechnical,
liberal arts degree the introductory knowledge base to enter the technology field or continue on for graduate study in computer science. For more information, visit the website http://www.cs.tufts.edu.

The program requires five Tufts courses:

**Computer Science 15 Data Structures**
**Computer Science 61 or Math 61 Discrete Mathematics**

Choose two:

**Computer Science 40 Machine Structure and Assembly Language Programming**
**Computer Science 105 Programming Languages**
**Computer Science 160 Algorithms**
**Computer Science 170 Theory of Computation**

One elective:
One computer science elective above **Computer Science 15**

*Prerequisite course **Computer Science 11: Introduction to Computer Science** is available for individuals without a previous programming course.

**Only one of **Computer Science 80 and 105 may be counted toward the program.

***Courses numbered above 100 award graduate credit, and are transferable into the Tufts Master of Science in Computer Science program upon acceptance to the program.

CERTIFICATE PROGRAMS

**Certificate Program in Computer Science**
The four-course, graduate-level certificate program in computer science is for the student with a bachelor’s degree in computer science or a closely related field with approved work experience. The program is designed for those who wish to update their skills and broaden their knowledge to meet the challenges of and opportunities available in today’s rapid-paced technology field.

The certificate requires four graduate-level courses in Computer Science. This flexible program allows the student to cluster course electives around a particular interest or specialty area. Courses may be chosen from our regular department offerings or from our Computer Science 150 Special Topics offerings, which are offered in particularly "hot" area of interest, or in a unique specialty area of Tufts faculty. For more information, visit the website http://www.cs.tufts.edu.

**Certificate Program in Human-Computer Interaction**
In an interdisciplinary collaboration between the Department of Psychology, the Department of Computer Science, the Department of Mechanical Engineering–Human Factors Engineering Program and the Department of Occupational Therapy at Tufts, this four-course, graduate-level certificate is designed to train the next generation of computer professionals for tomorrow’s complex challenges. The program is open to individuals with a bachelor’s degree, and is designed to be pursued on a part-time basis by computer programmers, Web designers, human factors professionals, software engineers, and user interface designers who wish to develop or enhance their user-interface design and implementation skills. For more information, visit the website http://www.cs.tufts.edu.

The certificate requires four courses.

1. Two foundation courses:
   **Computer Science 171 Human-Computer Interaction**
   **PSY 53 Introduction to Engineering Psychology or ENP 61 Introduction to Human Factors Engineering**

2. One or more of the following:
   **Computer Science 106 Object Oriented Programming for GUIs**
   **ENP 161 Human Factors in Product Design**
   **ENP 162 Man-Machine System Design**
   **ENP 166 Applied Design of Software User Interfaces**
   **PSY 130 Advanced Engineering Psychology**

3. Electives:
GRADUATE PROGRAMS

Master of Science

The Master of Science degree requires ten course credits at the 100 level or above. At least eight credits must be earned by taking approved courses. The remaining two credits may be earned by a combination of approved courses, a masters project or thesis, or participating in an independent study or research experience. At least four of the courses must be in computer science, and at least two of the courses must include a serious programming component. To use courses offered outside the Department of Computer Science, the student must obtain the approval of the department.

Students must also demonstrate competency as expected from a high-quality undergraduate program in computer science, in particular in the areas of Discrete Mathematics, Computer Architecture and Assembly Language, Programming Languages, Data Structures and Analysis of Algorithms, and Theory of Computation. These topics are covered, respectively, in Computer Science 61, 40, 105, 160, and 170. The courses 105, 160, and 170 may be taken as part of the master’s degree program.

Each student must also complete a master’s project or thesis demonstrating mastery of computer science research and/or software development skills. The project requirement includes a written report which must be approved by a member of the faculty. Substantial projects, typically involving research, can earn up to one credit through the courses Computer Science 293 and 294. The project requirement may also be satisfied by a written master’s thesis, defended orally, counted as between one and two credits, through the courses Computer Science 295 and 296.

Doctor of Philosophy

Students must have a master’s degree in computer science or a related field to be admitted to the Ph.D. program. Applicants to the Ph.D. program who do not have a master’s degree will instead be considered for admission to the M.S./Ph.D. program. Doctoral study consists of preliminary coursework and study, qualifying exams, and creative research culminating in a written dissertation. Detailed requirements and procedures for the Ph.D. program are outlined on the department web pages at [http://www.cs.tufts.edu](http://www.cs.tufts.edu).
Computer Science Certificate Program

Faculty advisor:
Associate Professor Anselm C. Blumer

With technology advancing at a rapid pace, opportunities for advanced applications of computer science are limitless. Professionals with experience and knowledge of the “hottest” topics in computer science—machine learning, computational biology, advanced programming languages, robotics, networks and cloud computing, visualization, parallel and distributed computing—are rapidly advancing in salary and opportunity. This four-course graduate-level program will update your skills and broaden your knowledge in computer science, through a “design your own specialty certificate” taught by Tufts’ renowned faculty in computer science. Completion of the certificate requires grades of B- or better in all courses. Courses are transferable into the Tufts M.S. program upon acceptance to that program.

The program is open to individuals with at least a bachelor’s degree in computer science, or a closely related field with approved work experience. Individuals completing the Post-Bac Computer Science Minor Program are also encouraged to apply.

For more information, contact the program administrator, Angela Foss, at 617-627-2320 or visit the website [http://www.cs.tufts.edu/Other-Graduate-Programs/computer-science-certificate-program.html](http://www.cs.tufts.edu/Other-Graduate-Programs/computer-science-certificate-program.html).
Consortium of Studies in Race, Colonialism, and Diaspora (RCD)

INTERIM DIRECTOR:
Associate Professor Kris Manjapra, History

The Consortium of Studies in Race, Colonialism, and Diaspora is the academic home for Africana, American, Asian American, Colonialism and Latino Studies—all programs that link innovative, progressive, and outstanding scholarship and learning on race, colonialism, and diaspora. Our work is interdisciplinary and intersectional in nature, combining topics and methods drawn from the humanities and social sciences and foregrounding the analytical, thematic, theoretical, and political linkages across existing programs in Africana Studies, American Studies, Asian American Studies, Colonialism Studies, and Latino Studies. The consortium programs allows for independent work within each major or minor of study, and also provides the opportunity to make connections across the specific areas and themes.

The programs housed within RCD connect the study of race, class, gender, and sexuality within the United States with the study of modern colonialisms in Africa, Asia, the Caribbean, Latin America, and the Middle East, and the social and cultural formations of diasporas. Students have the opportunity to be involved in the comparative and relational study of slavery in the Americas and its aftermath; the study of indigeneity within settler colonial societies; war, empire and militarization; and the movement, displacement, and settlement of peoples across the globe in a variety of time periods, including the contemporary era. Linking academic studies on race, colonialism, and diaspora, RCD features events, programs, exhibits, and workshops addressing these convergences.

Each of the five programs offers unique curricula leading to a major (Africana, American Studies) or minor (Africana, Asian American, Colonialism, or Latino Studies). Each of the five programs has a core faculty drawn from departments across Arts & Sciences.

NOTE: Students should check the RCD website (http://as.tufts.edu/RaceColonialismDiaspora) for more information and the respective major or minor program websites for requirements of each program and a list of courses that meet the requirements and/or meet with the director of the program that interests them.

Students interested in more information about the RCD and its programming may contact Associate Professor Kris Manjapra, History, Kris.Manjapra@tufts.edu; or Cynthia Sanders, Program Administrator, 110 Eaton Hall, 617-627-2311, Cynthia.Sanders@tufts.edu

Students interested in Africana Studies should contact Professor H. Adlai Murdoch, Director, H.Murdoch@tufts.edu.

Students interested in American Studies should contact Professor Heather Curtis, Director, Heather.Curtis@tufts.edu.

Students interested in Asian American Studies should contact Professor Natalie Masuoka, Director, Natalie.Masuoka@tufts.edu.

Students interested in Colonialism Studies should contact Professor Lisa Lowe, Director, Lisa.Lowe@tufts.edu.

Students interested in Latino Studies should contact Professor Helen Marrow, Interim Director, Helen.Marrow@tufts.edu.

Inquiries may also be made to Cynthia Sanders, Program Administrator, 110 Eaton Hall, 617-627-2311, Cynthia.Sanders@tufts.edu
Dance

Full-time Lecturer Renata Celichowska, Director of Dance; Modern, ballet, dance research and education, and creative process
Senior Lecturer Daniel McCusker, Modern, ballet, repertory and creative process

The Dance Program in the Department of Drama and Dance offers dance courses appropriate for both students new to dance and students with previous dance experience. The objectives of this non-conservatory program are to foster the development of creative resources and techniques, to introduce performance analysis, and to contextualize dance as an element of culture. This liberal arts approach encourages students to create integrative links with other disciplines. Students may minor in dance, and dance courses may be used toward the drama major (see Drama), and toward the fulfillment of arts, world civilization and cultural distribution requirements. Dance performances choreographed by faculty, students and Boston-area artists are presented on campus throughout each semester.

Dance Minor

The Dance minor requires five credits of six to eight half- and full-credit courses focusing upon techniques and processes for performing, creating, and analyzing movement materials in and outside of “western” traditions within their cultural and/or historical context. Requirements include one western experiential dance form, one non-western or diasporic experiential course, one creative process course, 6-8 dance elective courses, and a half-credit capstone research project (choreographic, performative or written). Only lecture courses in dance may be submitted for transfer approval, except for those in Tufts abroad programs. More information about dance may be obtained at 617-627-2555, at the department office or at http://ase.tufts.edu/drama-dance/dance/.
Drama and Dance

(FOR DANCE INFORMATION, SEE DANCE.)

Professor Heather S. Nathans, Chair; Theatre history, dramatic literature and criticism, directing
Assistant Professor Natalya Baldyga, Theatre history, dramatic literature and theory, directing
Professor of the Practice Jennifer Burton, Filmmaking and film studies
Lecturer Renata Celichowska, Director of Dance; Dance studies
Senior Lecturer Linda Ross Girard, Costume design; Director of Undergraduate Studies in Drama
Professor Barbara Wallace Grossman, Theatre history, dramatic literature and criticism, directing, voice
Lecturer Khary Jones, Filmmaking and film studies
Assistant Professor, Kareem Khubchandani, Performance Studies, Queer Studies
Lecturer Brian J. Lilienthal, Lighting design
Assistant Professor Noe Montez, Theatre history, dramatic literature and theory, directing; Director of Graduate Studies in Drama
Lecturer John Mulligan, Technical theatre
Associate Professor Monica White Ndounou, Theatre history, film studies, dramatic literature and criticism, acting
Senior Lecturer Daniel McCusker, Dance; Head of Dance Performance
Lecturer Kendra Bell Reddington, Costume Production and technology
Professor Laurence Senelick, Fletcher Professor of Oratory; Dramatic literature and theory, theatre and film history
Senior Lecturer Ted Simpson, Head of Design; Set design
Senior Lecturer Sheriden Thomas, Head of Acting
Lecturer Jo Williams, Stage Management

The Department of Drama and Dance celebrates the power of scholar-artists to engage with their society, pose challenging questions, and re-imagine the role of the arts in contemporary culture.

The undergraduate Drama program provides a strong liberal arts approach to the intellectual, historical, and aesthetic dimensions of dramatic performance. The Drama program integrates acting, design, dramatic literature, dramaturgy, directing, filmmaking, playwriting, screenwriting, technical theatre, and theatre history. The curriculum fosters creative, critical, and collaborative thinking. The Dance program offers a rich array of training and performing opportunities in styles including African dance, ballet, Kathak, hip-hop, jazz, modern, musical theatre, international folk, Dance on Camera, and Latin.

Drama and Dance courses and performances explore a wide range of styles and techniques. Students develop their powers of intellect and imagination. They learn to think precisely in the moment, to speak confidently in public, to write with clarity and intelligence, and to work productively with others.

The M.A./Ph.D. Program in Drama trains scholar-artists, with a focus on performance history, dramatic literature, and theory. The program emphasizes research with primary materials as well as field research. Students are encouraged to pursue their own scholarly interests under the guidance of faculty both in this department and in others on campus. The program is small enough to allow close relationships between students and faculty, with each degree candidate receiving personal attention.

PERFORMANCE ACTIVITIES

The production program allows students to explore all areas of theatre and dance outside the classroom. They are involved in every aspect of production, from backstage work as stage managers and crew members to directing and/or choreographing shows, designing, performing, and even producing. Students experience the joys and challenges of live performance, as well as the satisfaction of working as part of a creative ensemble on a project for a significant period of time.

We stage three major faculty-directed productions per year in Drama, plus two faculty-directed Dance concerts. The season is rounded out by numerous student-directed shows each semester, as well as our twice-annual “Dance Mash-Up.” Students may receive course credit for their involvement in departmental productions. Courses and productions are open to all Tufts students, regardless of major.

Several student groups are active throughout the year in the theatre and other spaces on campus. These groups include Pen, Paint, and Pretzels (3Ps), the largest theatre organization at Tufts;
Torn Ticket II, which is dedicated to musical theatre; and Bare Bodkin, specializing in student-written work. There are other performance opportunities with Cheap Sox (improvisational comedy), HYPE! (mime), and Traveling Treasure Trunk (children’s theatre).

UNDERGRADUATE CONCENTRATION REQUIREMENTS

Major in Drama
The major in drama provides a balanced mix of study and practice, understanding and process, creativity, adaptability, and analytical thinking. With its focus on effective communication and imaginative exploration, a drama major is one of the best preparations for a variety of careers, as well as for graduate professional training and work in a theatre arts specialization. Drama majors often complete double majors in combination with many other departments and programs.

The drama major consists of eleven course credits and related requirements, including:

1) Five course credits in history, literature, and/or theory of drama, three of which are required: Drama 2 (Ancient and Medieval Theatre), Drama 3 (Early Modern Theatre), and Drama 4 (Modern and Postmodern Theatre). The other two courses are electives from an approved list.
2) A theatre technology course chosen from the following offerings: Drama 16 (Costume Technology), Drama 17 (Theatre Technology), Drama 20 (Stage Engineering), or Drama 29 (Scene Painting).
3) A design course chosen from the following offerings: Drama 18 (Lighting Design), Drama 125 (Scene Design), or Drama 126 (Costume Design).
4) Two course credits in acting/directing/movement or studio dance/voice (excluding Drama 80).
5) Two electives in the student’s specific area of interest, at least one of which must be an upper-level course. A maximum of two one-half course credits of Drama 80 and/or 81 may be used to fulfill the requirements for the major.
6) A noncredit run crew on a faculty-directed major production (assistant stage manager, light board operator, sound board operator, costume crew, deck crew).
7) A noncredit prep crew on a faculty-directed major production consisting of thirty hours of production-related preparatory work in a given semester.
8) Each drama major is expected to gain experience in the creative aspects of drama and/or dance through involvement in the production program of the university. Graduating magna cum laude or summa cum laude with a drama major is contingent not only on scholastic achievement, but on significant participation in productions.

Students considering a drama major will find it advantageous to complete at least one of the required history/literature courses, the crew requirements, and an introductory-level course in either studio dance/acting or design/technology by the end of the sophomore year. This will allow greater flexibility in scheduling course work and more opportunities for advanced-level production responsibilities later on.

We strongly recommend that students who plan to pursue professional training or graduate school take more than the eleven-course credit minimum, especially in their intended area of specialization.

UNDERGRADUATE MINOR PROGRAMS

Minor in Drama
The drama minor consists of a minimum of five courses taken in the department: two in literature/history (including either Drama 2, 3, or 4) and three other courses selected in a plan approved by the designated minor advisor. Drama minors have the option of choosing an emphasis in acting, directing, design, technical theatre, or theatre studies. Drama minors are also required to serve on either one prep crew or one run crew for a departmental major production.

Interdisciplinary Minor in Film Studies
This interdisciplinary minor is offered through the Film and Media Studies program. For more information, see the Film and Media Studies website at http://ase.tufts.edu/cms.

Interdisciplinary Minor in Multimedia Arts
This interdisciplinary minor is offered through the Film and Media Studies program. For specific information about the policies governing requirements and electives, visit http://ase.tufts.edu/cms/mma.html.
Graduate Program

For admission to graduate work in drama, a prospective student must present a completed undergraduate record of high scholastic proficiency with a firm grounding in drama and theatre arts. Other desirable foundation subjects include cultural studies, art history, music, philosophy, psychology, sociology, history, and literature.

The program of study leading to the doctor of philosophy or master of arts degree in drama embraces dramatic literature, dramatic theory and criticism, and theatre history and research. It is expected that applicants for admission will already have attained a level of proficiency in the creative and/or performance aspects of theatre.

Courses of study for the satisfaction of the residence requirement do not include theatrical practice or stage performance. Dramaturgy or assistant direction for a faculty-directed play may be used for credit once. Depending on the individual student's educational background, intellectual capabilities, and professional aims, certain courses in other disciplines—anthropology, art history, Chinese, classics, English, French, German, history, Italian, Japanese, music, philosophy, Russian, sociology, and Spanish—may be taken for credit toward advanced degrees in drama, upon consent of the graduate advisor of the Department of Drama and Dance.

Master of Arts

In general, the student is expected to offer for admission the equivalent of a Tufts bachelor of arts degree with a major in drama. A student whose undergraduate preparation is not equivalent may be admitted provisionally and may be required to complete more than the minimum eight courses or make up deficiencies at no degree credit.

Requirements and Residence

A minimum of eight courses of graduate-level work in residence is required for the degree. Additionally, the student must satisfy the following requirements to qualify for the master of arts degree in drama:

1) The student must demonstrate a reading knowledge of a foreign language by passing an examination or an approved course no later than the end of the first year. A student whose undergraduate record indicates successful performance in a language course at the advanced level may be exempt.
2) The student must take a minimum of four courses in graduate seminars selected from the following: Drama 220, 231, 235, 236, 240, 244, 248, 249, 251, 252, 254, 255, 258, 259, 261, 262, 263, or other special topics seminars offered by the department. Also, certain related courses in other departments may be credited toward the master of arts degree in drama (not more than one in a semester), with prior consent of the advisor.
3) The student must demonstrate an ability to deal with the concepts and problems of a particular area of scholarly specialization at a level of distinction. The student must satisfy this requirement by completing a scholarly thesis (one semester of Drama 295 or 296).

Policy on Incomplete Grades

Any graduate student with more than one incomplete grade at the end of a term's study will receive warning that his or her status in the program is in jeopardy. Any student on financial aid or assistantship who has more than one incomplete grade at the end of a term's study will have his or her appointment withdrawn.

All incomplete grades must be completed no later than six weeks after the end of the semester or summer session in which the incomplete was awarded or the student will be required to withdraw from the program.

The above stipulations may be waived only by petition of the student, supported with the appropriate medical or university documentation, and the voting consent of the graduate faculty.

Doctor of Philosophy

For admission to the program the applicant is generally expected to offer the equivalent of a Tufts master of arts degree in drama and to provide evidence of experience in theatrical production on his or her résumé. A student whose prior preparation is not equivalent may be admitted provisionally and required to take additional courses achieving a grade not lower than B- to make up deficiencies at no degree credit.
REQUIREMENTS AND RESIDENCE
Course work extending approximately three academic years beyond the B.A. degree, normally 18 courses (including two courses for dissertation research), is required. Part-time study or less than full-time residence in the Ph.D. program is discouraged. Eight seminars within the department are required of all Ph.D. students, including two seminars in dramatic or performance theory and Drama 220: Introduction to Research Methods and Materials (to be taken on entering). With prior consent of the advisor, certain advanced courses outside the department may be credited toward the Ph.D. degree (not more than one course in a semester).

Students with a master’s degree may be credited toward the doctorate with up to six courses in their previous graduate study that satisfy course requirements for the Tufts doctorate in drama. However, acceptance into candidacy for the doctoral degree ordinarily depends on the quality of work done in the student's first year of residence at Tufts. Transfer of courses is not automatic, and each case is judged on its individual merit by the graduate faculty. A student may apply for transfer of courses earned through graduate work in other schools only after the satisfactory completion of at least one semester of residence at Tufts.

POLICY ON INCOMPLETE GRADES
Doctoral candidates should note the restrictions on incomplete grades stated in the section on the master’s degree.

FOREIGN LANGUAGE
A student must demonstrate a reading knowledge of two foreign languages. Because a significant amount of material in this program can be read only in primary sources, the student is expected to satisfy the language requirements by passing an examination or accepted course in one language no later than the end of the first year of residence, and the other language prior to taking the comprehensive examinations. A student whose undergraduate record indicates successful performance in a language course at the advanced level may be exempt.

COMPREHENSIVE EXAMINATIONS
After the last semester of courses, the student will complete comprehensive examinations to establish his or her candidacy for the doctoral degree. These examinations will be both written and oral.

DISSERTATION
The candidate for the doctoral degree must prove competence in independent research by preparing and completing a dissertation on a subject chosen and planned with the approval of the department's graduate faculty and written under the supervision of an advisor. Ordinarily the student will complete the dissertation while in residence, although for special reasons he or she may be permitted to finish it elsewhere within the time limit established by the graduate school.

COURSES AVAILABLE IN THE DOCTORAL DEGREE PROGRAM
Although each course is not offered every year, the student may expect to find most of them available during the period of residence. A doctoral candidate is expected, as part of the course load, to enroll in a minimum of two seminars each semester (200-level courses).

For more detailed information, please visit the website http://ase.tufts.edu/drama-dance.
Earth and Ocean Sciences

Professor Jack C. Ridge, Chair; Quaternary, glacial, and environmental geology; geomorphology; paleomagnetism
Professor Grant Garven, Groundwater geology and hydrology, groundwater chemistry
Associate Professor Anne F. Gardulski, Sedimentology, structural geology, stratigraphy
Assistant Professor Andrew C. Kemp, Coastal systems, sea level change, oceanography, modern and paleo-climate change
Senior Lecturer Jacob S. Benner, Paleoecology, stratigraphy, ichnology, GIS applications

ASSOCIATED FACULTY:
Professor Samuel Kounaves, Chemistry; Analytical, environmental, and planetary chemistry
Associate Professor Laurie Baise, Civil and Environmental Engineering; Geotechnical and earthquake engineering

The Earth and ocean sciences are an interdisciplinary exploration of Earth’s 4.5-billion-year history and a study of the geological processes that form and shape the rocks and minerals of our planet and other planetary bodies. Earth and ocean sciences have their own bodies of knowledge, but also draw on principles from biology, chemistry, astronomy, physics, and mathematics. Earth scientists are involved in studying a great variety of problems, such as the search for natural resources including water, unraveling the causes and effects of climate change, tracing the evolution of organisms and ecosystems through geologic time, and understanding the origin of the bodies in our solar system. The program in Earth and Ocean Sciences, complemented by courses in supporting sciences, will prepare students well for graduate study or careers in an array of fields. Tufts University has well-equipped geological laboratories and an excellent collection of geologic materials for study and research. Research experiences with faculty and field trips in the northeastern and southwestern United States offer abundant opportunities for the study of a great variety of geological phenomena.

UNDERGRADUATE CONCENTRATION REQUIREMENTS
The Department of Earth and Ocean Sciences offers two programs: the geological sciences major, for students who wish to pursue graduate study in Earth and ocean sciences and related fields, or work at entry-level jobs; and the geology major, which emphasizes breadth and flexibility for students seeking a double major, teaching certification, entry to medical programs, or careers in multidisciplinary fields such as environmental law.

Geological Sciences Major
Students intending to continue with Earth and ocean sciences after graduation should complete the following courses: EOS 1, 2, 11, and 22. In addition, students must select a total of six more courses from the following groups: three courses from EOS 12, 13, 32, and 42; one course from EOS 131 and 133; and two courses above EOS 9 or from approved related fields courses. In addition, students must complete Mathematics 32, Chemistry 1 or 11, and Physics 1 or 11, and select two courses from Mathematics 34, Chemistry 2 or 12, Physics 2 or 12, and one course in statistics, selected from Mathematics 21 and Biology 132. The Chemistry and Physics courses must be taken with labs. Research experience and a six-week summer field camp are strongly recommended.

Geology Major
Students electing this option should complete EOS 1 and 2, eight other EOS courses (except EOS 9), plus Chemistry 1 or 11 and Physics 1 or 11 with labs. Approved related fields science courses may replace as many as three of the upper-level EOS courses for Arts and Sciences students. Engineering students with a double major in geology may use upper-level engineering courses to substitute for up to two of the upper-level EOS courses with prior written consent. No more than a total of four upper-level EOS courses may be replaced by engineering and related fields courses for engineering students.

UNDERGRADUATE MINOR PROGRAMS
Geology Minor
The Department of Earth and Ocean Sciences offers a minor in geology available to students in the School of Engineering. The faculty advisor for this minor is Professor Anne Gardulski.

Five courses are required for the minor. They normally include:
EOS 1 The Dynamic Earth
EOS 2 Environmental Geology
EOS 22 Structural Geology or EOS 32 Geomorphology
EOS 131 Groundwater

One elective selected from the following:
EOS 22 Structural Geology
EOS 32 Geomorphology
EOS 42 Sedimentology and Stratigraphy
EOS 115 Quaternary and Glacial Geology
EOS 132 Groundwater Chemistry and Quality
EOS 133 Field Methods in Hydrogeology

Note that EOS 1, 2, 22, 131, 132, and 133 are generally offered every year, but EOS 32, 42, and 115 are offered in alternate years. Schedule planning for these courses is important.

**Geoscience Minor**
The Department of Earth and Ocean Sciences offers a minor in geoscience available to Arts and Sciences students who are majoring in archaeology, biology, chemistry, computer science, mathematics, physics and astronomy, or quantitative economics. The faculty advisor for this minor is Professor Anne Gardulski.

Five courses are required for the minor. They normally include:
**EOS 1 The Dynamic Earth**
**EOS 2 Environmental Geology**

Three electives are also selected, in consultation with the faculty advisor. These courses are intended to complement the student’s major and scientific or mathematical interests.

**Geoengineering Minor**
The Department of Civil and Environmental Engineering offers a minor in geoengineering available to students of the College of Liberal Arts and the School of Engineering, except those majoring in civil and environmental engineering. Professor Lewis Edgers is the advisor for the minor.

Five courses are required:
**Engineering Science 5 Applied Mechanics (Statics)**
**Engineering Science 9 Applied Mechanics (Strength of Materials)**
**Civil and Environmental Engineering 12 Introduction to Hydraulic Engineering**
**Civil and Environmental Engineering 42 Introduction to Geotechnical Engineering**

One elective selected from:
**Civil and Environmental Engineering 112 Hydrology and Water Resource Engineering**
**Civil and Environmental Engineering 113 Groundwater**
**Civil and Environmental Engineering 146 Foundation Engineering**
**Civil and Environmental Engineering 149 Earth Support Systems**

Prerequisites for the above course sequence are Mathematics 34 and Physics 12.

For more detailed information, please see the website [http://eos.tufts.edu](http://eos.tufts.edu).
Economics

Professor Daniel Richards, Chair; Industrial organization, macroeconomics
Professor Marcelo Bianconi, Macroeconomics, international economics, finance
Professor Ujjayant Chakravorty, Resource and environmental economics, energy and water resources, climate change
Professor Yannis Ioannides, Max and Herta Neubauer Chair in Economics; macroeconomics, growth, urban economics, housing
Associate Professor Margaret McMillan, Development economics
Professor Gilbert E. Metcalf, Public finance, applied microeconomics
Professor Lynne Pepall, Industrial organization, applied microeconomics
Professor Enrico Spolaore, Political economics, international economics, macroeconomics, economic growth/development
Professor Jeffrey Zabel, Director of Graduate Studies; Econometrics, labor economics
Associate Professor Drusilla Brown, International trade theory and policy
Associate Professor Thomas Downes, Public finance, economics of education
Associate Professor David Garman, Applied econometrics
Associate Professor Edward Kutsoati, Director of Undergraduate Studies; Money and financial markets, applied microeconomics
Associate Professor Melissa McInerney, Health and labor economics
Associate Professor Margaret McMillan, Development economics
Assistant Professor Kyle Emerick, Agricultural economics, economic development, food and nutrition
Assistant Professor Federico Esposito, Microeconomics, macro-labor, international macroeconomics, monetary economics
Assistant Professor Laura Gee, Applied microeconomics, behavioral and experimental economics
Assistant Professor Kelsey Jack, Environmental economics, economic development, behavioral economics
Assistant Professor Muthoni Ngatia, Development economics, applied microeconomics
Assistant Professor Sahar Parsa, Macroeconomics, finance
Assistant Professor Adam Storeygard, Development and growth, urban economics
Senior Lecturer Anna Hardman, Urban economics, housing, international migration, development economics
Professor of the Practice Judith Bentkover, Health economics
Professor of the Practice Christopher Manos, Finance, entrepreneurship

SECONDARY APPOINTMENTS:
Adjunct Associate Professor Jenny Aker, Development economics
Adjunct Professor Michael Klein, International economics, macroeconomics
Adjunct Professor William Masters, Development economics, food and food industry

The mission of the department is to teach students to be critical thinkers and to use the discipline of economics to analyze and solve problems associated with important economic, political and social issues. These issues range from international economic relations to economic development, growth, income inequality, environment, education, housing and competition policy. The courses that we offer, along with our continuing interaction with other scholars at Tufts and elsewhere, help prepare our students to be leaders in the community at large after they leave the university.

UNDERGRADUATE CONCENTRATION REQUIREMENTS
Courses that can be offered to meet the concentration requirement in economics must satisfy the department’s policies as outlined in the Economics Department Handbook, available from the department or on the department’s website at http://ase.tufts.edu/economics/undergrad/requirements.htm. The handbook contains information on grading standards, acceptability of courses taken at Tufts and elsewhere, and other details of the concentration requirements.

There are two options available for the student who wishes to concentrate in economics. Option I, the major in economics, is less structured and allows greater flexibility in the choice of courses. Option II, the major in quantitative economics, is designed for students with an interest in mathematics and statistical methods. This option is best for those who are contemplating graduate study in economics or the more quantitative areas of business and finance.
Each economics major must complete three levels of courses: mathematics courses, normally completed by the end of the sophomore year; core courses, which cover the elements of economic theory and method; and elective courses. Elective courses are selected by the student but must meet criteria summarized below and detailed in the handbook. Normally, students should satisfy the prerequisite prior to enrolling in any core course, and should complete the core courses prior to taking elective courses. A minimum grade of C- is required for all core and elective courses used to satisfy these concentration requirements. Both Option I and Option II place restrictions on the student’s choice of electives; these restrictions are summarized below.

**Option I: Major in Economics**

**PREREQUISITE**
Principles of Economics (Economics 5) or equivalent.

**MATHEMATICS COURSE(S)**
Mathematics 32, or any higher-level mathematics course approved by the department. Students can waive all or part of this requirement by showing adequate prior preparation as determined by the Departments of Economics or Mathematics (for example, through the Advanced Placement tests). Students may substitute Mathematics 14 and 30 for Mathematics 32. Students who make this substitution and who complete a second concentration must keep in mind that, for purposes of determining the number of courses that can overlap between the economics concentration and the second concentration, the economics concentration requires ten courses.

**CORE COURSES**
Four core courses are required: Intermediate Microeconomics (Economics 11), Intermediate Macroeconomics (Economics 12), Statistics (Economics 13), and Basic Econometrics (Economics 15). These courses serve as prerequisites for most upper-level economics courses. In place of Economics 13, students can take Mathematics 162, Engineering Science 56, Electrical Engineering 104 or Economics 201. Courses in other Tufts departments are normally not accepted as substitutes for Economics 13. In place of Economics 15, students can take Economics 107 or Economics 202. In place of Economics 18, students can take Economics 205.

**ELECTIVE COURSES**
Majors must successfully complete five upper-level economics courses numbered Economics 20 or above. At least three of these five courses must be courses numbered at the 100 level or above. See the handbook for details.

Beginning with the class of 2019, all majors are required to take at least one upper level seminar class. Upper level seminars are courses that focus on a specialized topic in the field of economics. Because of this specialized focus, all seminars have at least one of the core courses (Economics 11, Economics 16, Economics 12/18, Economics 13, Economics 15/107) as a prerequisite. In addition, seminars are small classes that place an emphasis on class interactions, the writing of papers, and the reading of journal articles. Seminar courses provide alternative ways to have “hands-on” research experience that underlie the seminar requirement. This experience could be offered by a required research paper. However, courses that ask students to complete a series of short policy briefs, a critical literature review, or a group project that requires substantive research and writing may count as seminars. Courses that satisfy the seminar requirement are denoted with an ampersand (&) in the department’s course offerings located at [http://ase.tufts.edu/economics/courses/offerings.htm](http://ase.tufts.edu/economics/courses/offerings.htm)

**Option II: Major in Quantitative Economics**

**PREREQUISITE**
Principles of Economics (Economics 5) or equivalent.

**BASIC MATHEMATICS COURSES**
Mathematics 32 and 34. Students can waive all or part of this requirement by showing adequate prior preparation as determined by the Departments of Economics or Mathematics. Students should be aware that Mathematics 39 and 44 can be offered as substitutes for Mathematics 32, 34, and 42.

**CORE COURSES**
Five core courses are required: Intermediate Microeconomics (Economics 11); Statistics (Economics 13),
Foundations of Quantitative Economics (Economics 16) or Microeconomic Theory I (Economics 203), Quantitative Intermediate Macroeconomics (Economics 18) or Macroeconomic Theory I (Economics 205), and Econometrics (either Economics 107 or 202). Students must complete Economics 11 before taking Economics 16 or 203. In turn, students must complete Economics 16 or 203 before taking Economics 18 or 205. One core mathematics course is also required: Mathematics 70 or 72. No course offered as a core course can also be used as an elective course. In place of Economics 13, students can take Mathematics 162, Engineering Science 56, Electrical Engineering 104 or Economics 201.

**ELECTIVE COURSES**

Quantitative economics majors must complete four additional upper-level economics courses numbered Economics 20 or above. There are three restrictions on choice. First, at least three of these four courses must be suitable courses at the 100 level or higher. Second, at least one elective course must be open only to students who have completed the relevant quantitative prerequisite course (Economics 16, 18, or 107) or its equivalent.

The third restriction varies depending on the student’s graduation year. Beginning with the class of 2019, all majors are required to take at least one upper level seminar class. Upper level seminars are courses that focus on a specialized topic in the field of economics. Because of this specialized focus, all seminars have at least one of the core courses (Economics 11, Economics 16, Economics 12/18, Economics 13, Economics 15/107) as a prerequisite. In addition, seminars are small classes that place an emphasis on class interactions, the writing of papers, and the reading of journal articles. Seminar courses provide alternative ways to have “hands-on” research experience that underlie the seminar requirement. This experience could be offered by a required research paper. However, courses that ask students to complete a series of short policy briefs, a critical literature review, or a group project that requires substantive research and writing may count as seminars. Courses that satisfy the seminar requirement are listed with an ampersand (&) in the Department’s Course Offerings.

Quantitative Economics majors graduating before 2019 must include in their four electives either at least one of the upper level seminar classes described above; or at least one of the 100-level economics courses that are explicitly designated as a “research-paper course,” or a senior thesis credit. Research-paper courses are denoted with an asterisk (*) in the department’s course offerings located at [http://ase.tufts.edu/economics/courses/offerings.htm](http://ase.tufts.edu/economics/courses/offerings.htm).

**Recommendations for Honors**

To receive the department’s recommendation for summa or magna cum laude, eligible candidates must demonstrate outstanding intellectual force. Included in the ways the department judges this attribute are active contribution in classes; superior performance in the core courses of intermediate micro and macro theory, statistics, and econometrics; quality of projects pursued, especially class and seminar papers; and quality of a written thesis and its defense. Students wishing to be reviewed for magna or summa honors must complete at least one economics course which is explicitly designated as a “research-paper course” by the department, and which has Economics 11/16, 12/18, or 13 as a prerequisite. Research-paper courses are denoted with an asterisk (*) in the department’s course offerings located at [http://ase.tufts.edu/economics/courses/offerings.htm](http://ase.tufts.edu/economics/courses/offerings.htm).
Principles of Economics (Economics 5) or equivalent

CORE COURSES
Intermediate Microeconomic Theory (Economics 11 or 16 or 203) and either Intermediate Macroeconomics (Economics 12 or 18 or 205) or Statistics (Economics 13 or 201, Mathematics 162, Engineering Science 56, or Electrical Engineering 104)

ELECTIVE COURSES
Minors must successfully complete two elective courses in economics. These two elective courses must include one from Economics 12 or above and one from Economics 100 or above. Exceptions will be made for those who wish to use both Economics 86 and Economics 87 as electives and for those who wish to use Economics 15 as their upper-level (above Economics 100) elective. Courses offered to complete the core may not be counted as electives.

Minor in Finance
The minor in Finance is a six-course interdisciplinary minor that gives students a foundation in the formal economics of financial markets and supplements that foundation with important mathematical and philosophical tools. The courses in the minor address the study of intertemporal pricing, theoretical and empirical analysis of decision-making under uncertainty, and both positive and normative issues in settings of asymmetric information.

As described below, the six courses in the minor include the three core classes, two electives, and a capstone seminar. Within this structure, Economics 50 may not be double-counted for both a Finance minor and either an Economics or a Quantitative Economics Concentration. Either Economics 157 or Philosophy 197 may be taken in connection with a concurrent internship with the consent of the course instructor and the Finance minor advisor. At most, one Finance minor elective may be double-counted as an Economics or Quantitative Economics major elective.

CORE COURSES
The core classes for the minor in Finance are Economics 50, Introduction to Finance; Mathematics 32, Calculus 1; and either Philosophy 24, Introduction to Ethics, or Philosophy 38, Rational Choice.

ELECTIVE COURSES
Finance minors must complete any two of the following classes to fulfill their electives requirement: ELS 103, Entrepreneurial Finance; Economics 150, Financial Economics; Economics 151, Monetary Economics; Economics 152, Topics in Money and Finance; Economics 154, Uncertainty Methods in Economics and Finance; Economics 159, Quantitative Financial Economics; and Economics 169, Quantitative International Finance.

CAPSTONE COURSE EXPERIENCE
In order to fulfill the Capstone Course requirement, each Finance minor must complete either Economics 157, Topics in Finance and Entrepreneurship, or Philosophy 197, Ethics, Law and Society.

For questions about the minor in Finance, please contact Professor Chris Manos, who serves as advisor to the program.

GRADUATE PROGRAM
Master of Science
The Economics Department offers a Master of Science (M.S.) program. Candidates normally will have completed the work required for a baccalaureate degree. Although concentration in Economics is not required, some exposure to the subject is preferred, especially in the areas of intermediate theory, mathematics and statistics. Students lacking this minimum training, but possessing a good background in a related discipline, may be admitted with the understanding that additional work will be required. The department offers a mathematics review course (Math Camp), which lasts one week and takes place at the end of August, before the first day of classes in the Fall term. All applicants, except Tufts undergraduates in arts and sciences, must submit the Graduate Record Examination (GRE) with their application.

The Master of Science Program in Economics has two tracks: Course-Based and Research-Based. The M.S. Course-Based track is an eight-credit program, which can be completed in one year, without a thesis. The M.S. Research-Based track is a twelve-credit program to be completed in two years, with a master’s
All entering students will be admitted to the Master of Science program in Economics and will be asked about their potential interest in pursuing either the M.S. Course-Based or the two-year M.S. Research-Based degree. All students are required to complete the three core sequence classes: Statistics and Econometrics; Microeconomic Theory I and II; and Macroeconomic Theory I and II. The standard course load for a full-time student is four courses per semester.

**Course-Based Master of Science in Economics**
The Course-Based track requires completion of six core courses (Economics 201–Economics 206), and two electives, for a total of eight credits. Electives include courses offered in the Department of Economics, courses offered in other departments at the School of Arts, Sciences, and Engineering, and at the Fletcher School, as well as at other consortium schools (Boston College, Boston University, and Brandeis University). In order to receive the Master of Science Course-Based degree, a student must complete a one-year residency requirement and must pass eight semester courses.

**Research-Based Master of Science in Economics**
The requirements for the Research-Based degree, in addition to the eight-credit course requirements of the Course-Based track, include four extra credits: two master thesis credits, an Economics Research Seminar, and an Applied Econometrics course. To be admitted into the Research-Based Master of Science degree in the second year, students must demonstrate good standing in the first year of the program.

Specifically, a full-time M.S. Research-Based student will have to (1) show math competency by the end of the first (Fall) semester; (2) receive a final grade of B or better in all six courses (Economics 201–Economics 206), and a grade of A or better in at least two of those classes; (3) demonstrate ability to conduct independent research. Students in the M.S. Research-Based degree must complete twelve credits. The thesis must be a major research project conducted under the supervision of the member of the department. The completed thesis must be presented and successfully defended in an oral examination administered by a thesis committee. In order to receive the Master of Science Research-Based degree, a student must complete a two-year residency requirement and must pass twelve semester courses.

Financial aid, scholarships, teaching and research assistantships and other opportunities are available. The department considers all teaching and research experience to be an integral part of the program.

**JOINT MASTER OF SCIENCE IN ECONOMICS AND URBAN AND ENVIRONMENTAL POLICY**
In addition to the regular master’s program, the Economics Department also offers a two-year program, in conjunction with the Department of Urban and Environmental Policy and Planning, leading to the joint degree of Master’s in Economics and Urban and Environmental Policy. Applicants to this program must be accepted by both departments.

For more detailed information, please visit the website: [http://ase.tufts.edu/economics/grad/joint.htm](http://ase.tufts.edu/economics/grad/joint.htm)

**Ph.D PROGRAM IN HUMAN DEVELOPMENT ECONOMICS**
The Eliot-Pearson Department of Child Study and Human Development (CSHD) and the Department of Economics are pleased to offer a joint Ph.D. program in Human Developmental Economics (HDE) drawing on the strengths of the two departments and recent trends and complementary advances in both disciplines. This interdisciplinary doctoral program aims to better understand human development through the study of cultural, social, emotional, economic and behavioral interactions as they contribute to socialization and decision making. This program is new within the existing CSHD Ph.D. Program as of Fall 2016.

For more detailed information, please visit the website: [http://ase.tufts.edu/economics/grad/PhD.htm](http://ase.tufts.edu/economics/grad/PhD.htm)

**Ph.D PROGRAM IN ECONOMIC ANALYSIS**
The Department of Economics and the Fletcher School of Law and Diplomacy are pleased to offer a joint Ph.D. program in Economic Policy. This inter-school and inter-disciplinary program will focus on formal analysis and policy evaluation in the areas of energy, environmental, and development economics, including the political economy underlying actual policy practice. This program is new and will first be open to student applications in the Fall of 2016.

For more detailed information, please visit the website at: [http://ase.tufts.edu/economics/grad/PhD.htm](http://ase.tufts.edu/economics/grad/PhD.htm)
Education

Professor David Hammer, Chair and Director, STEM Education
Professor Bárbara M. Brizuela, Dean of Academic Affairs, Mathematics Education
Associate Professor Sabina Elena Vaught, Director, Educational Studies
Assistant Professor Julia Svoboda Gouvea, Science Education
Assistant Professor Brian Gravel, Director, Elementary STEM Education, Science Education
Assistant Professor Shameka Powell, Educational Studies, Literacy
Research Assistant Professor Jessica Watkins, Science and Engineering Education
Senior Lecturer Linda Beardsley, Director, Middle and High School Education and School Partnerships
Senior Lecturer Steve Cohen, Middle and High School Education, History and Political Science/Political Philosophy
Senior Lecturer Steven Luz-Alterman, Associate Chair and Co-Director, School Psychology
Senior Lecturer Laura Rogers, Co-Director, School Psychology
Lecturer Susan Barahal, Director, Art Education
Lecturer Pamela Bower-Basso, Art Education
Lecturer Silas Pinto, School Psychology
Lecturer Ryan Redmond, Middle and High School Education
Lecturer Cynthia Robinson, Director, Museum Studies
Lecturer Erin Seaton, School Psychology, Learning and Development

SECONDARY APPOINTMENTS:
Adjunct Assistant Professor Kristen Bethke Wendell, Engineering Education

The department is home for the study of, simply put, how people learn and how to help people learn. Much of our work focuses on K–12 schools, but we study education in other contexts as well, including museums and universities. Many of our students are preparing to work in schools, as teachers or as school psychologists; some are preparing for careers in museums and some for careers in education research. Students in other departments may take our courses who plan to become professors, for example, or designers of educational technology.

Our programs for prospective educators prepare students for the scholarship of professional practice, such as in teachers’ exploration and assessment of their students’ ideas and reasoning, in school psychologists’ examination of children’s strengths and needs, or in museum educators’ study of visitors’ learning experiences.

Scholarship in education also includes research, such as in studies of the cultural, historical, and philosophical influences that shape schools as institutions, in investigations of the nature and dynamics of learning in particular academic disciplines, or in analyses of teachers’ thinking. Faculty in the department conduct research on learning and teaching in STEM disciplines (Science, Technology, Engineering, and Mathematics) as well as on educational inequities and the dynamics of race, gender, and power in institutional contexts. Students have opportunities to participate in this research, which often takes place in collaboration with other academic departments on campus as well as with the Center for Engineering Education and Outreach.

UNDERGRADUATE PROGRAMS

The department offers both a minor and a major in Education, the latter as a second major only. The minor requires 5 courses, the major 10, and there are two possible concentrations for each:

Educational Studies focuses on social and cultural foundations with particular attention to race, gender, sexuality, and other dimensions of societal organization. Students will study "critical theory" with respect to educational practices and institutions.

Teaching and Learning focuses on education within academic disciplines (art, history, a science, math, languages, engineering). Students will work with their major advisor to construct a program related to their primary major and interests.

For more information, please see ase.tufts.edu/education/programs/undergraduate.

Undergraduate contacts: Sabina Vaught (Educational Studies) and David Hammer (Teaching and Learning).

GRADUATE PROGRAMS
The department offers a range of graduate programs. These include three Master of Arts in Teaching (M.A.T.) programs for licensure in Middle and Secondary Education, Elementary Education, and Visual Art. The department also supports two Master of Arts (M.A.) programs toward credentials in German and in Latin and the classical humanities.

The Master of Arts/Educational Specialist program (M.A./Ed.S.) in School Psychology prepares students for state licensure and national certification as school psychologists. The M.A. in Museum Education prepares students for careers in museum settings.

The M.A. in Educational Studies focuses on the study of race, gender, sexuality, class, and other categories of identity, culture, and institutional and structural power. The Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) programs in STEM Education focus on the study of learning and teaching in STEM disciplines.

Most students are full-time; some programs support part-time study. To accommodate employed teachers who must conduct advanced work on a part-time basis, a considerable portion of the department’s graduate instruction is offered during late afternoon, evening, and summer sessions.

For more information on any program, please see asc.tufts.edu/education/programs/.

**Master of Arts in Teaching (M.A.T.) Degree: Middle and Secondary**
The department’s state-approved M.A.T. degree programs prepare candidates to teach in a range of academic fields; completion of an M.A.T. satisfies requirements for initial licensure in Massachusetts. The Urban Teacher Training Collaborative (UTTC) provides opportunities for students to work as year-long interns in one of our partnering public schools, including the Boston Arts Academy, Codman Academy, Fenway High School in Boston; Malden High School and Linden STEAM Academy in Malden, Medford High School and Somerville High School. The UTTC is the oldest program of its kind in the region, with a long-standing commitment to teacher preparation.

**Master of Arts in Teaching (M.A.T.) Degree: Elementary STEM**
The department offers a state-approved program in elementary education, with a specialization in STEM fields. Students are prepared to teach all subjects in a general education classroom, while spending additional time developing expertise in the teaching of science, technology, engineering, and mathematics. Students in this program are placed in partnering urban districts (in collaboration with the UTTC) as interns throughout the entire school year. Graduates receive initial teaching licensure for elementary grades 1–6 with the SEI Endorsement, and they have the opportunity for an additional license in Moderate Disabilities.

**Master of Arts (M.A.) Degrees: German and Latin and Classical Humanities**
The MA in German with Teaching Licensure is a 14-credit program satisfying requirements for initial state licensure in German, offered in conjunction with the Department of International Literary and Cultural Studies. The MA in Classics with Teaching Licensure is also 14 credits, satisfying requirements for initial state licensure in Latin and Classical Humanities, offered in conjunction with the Department of Classics.

**Master of Arts in Teaching (M.A.T.) Degree: Art Education**
This program prepares the artist to teach in elementary, middle, and high schools. Students explore art making and works of art through a variety of cultural, historical and socio-political lenses to make art accessible and sustainable for all students in diverse communities and with a focus on interdisciplinary and global connections. The program is offered in affiliation with the Tufts School of the Museum of Fine Arts and leads to licensure as a teacher of visual art for grades pre-K to 8, or 5 to 12.

**Master of Arts (M.A.)/Educational Specialist (Ed.S.) Degrees: School Psychology**
This three-year program combines advanced course work with a specific sequence of field-based training and supervision in the core areas of assessment, intervention and consultation. These are anchored in a developmental perspective promoting the social, emotional and intellectual growth of children and adolescents. Problem-solving methods are emphasized as critical to understanding and proposing solutions to challenges in educational settings. Students complete a minimum of 1,950 hours of supervised field experience over the three years. Attendance during the summers is required. Students earn the Master of Arts and Educational Specialist degrees leading to initial licensure as a school psychologist in Massachusetts and eligibility for national certification.

**Master of Arts (M.A.) Degree: Museum Education**
This interdisciplinary program prepares students for museum careers such as teaching; outreach; community engagement; evaluation; and school, family, teacher, and public program development and management. Graduates work in art, history, science, and children's museums all over the world.

**Master of Arts (M.A.) Degree: Educational Studies**
Students in this program explore education as a site and dynamic of critical scholarly analysis through the disciplinary strands of the field, including history, sociology, anthropology, and philosophy. The program offers students the opportunity to examine a range of education topics in relation to the study of race, gender, sexuality, class, and other categories of identity, culture, and institutional and structural power. Additionally, students are trained to engage these topics through theoretical frames such as feminist and queer theories, critical race theory, socio-cultural theories, and others.

**Master of Science (M.S.), Doctor of Philosophy (Ph.D.) Degrees: STEM Education**
Students work in mathematics, science, and/or engineering education. The M.S. program is preparation for research, curriculum development, and teacher development in school districts, research institutions, and other educational settings, as well as for further study. The Ph.D. program is preparation for research leadership, including as faculty in higher education. The program involves collaborating faculty from Child Development, Mechanical Engineering, Computer Science, Biology, Chemistry, Mathematics, Physics and Astronomy, the Center for Engineering Educational Outreach, and the Center for Science and Mathematics Teaching.

**Master of Science (M.S.), Doctor of Philosophy (Ph.D.) Degrees: STEM Education, Physics Education Track**
The Physics Education Track is a collaboration with the Department of Physics and Astronomy, beginning in Fall 2014. Students enrolled through Education complete requirements in physics, to show proficiency across classical mechanics and electromagnetism, statistical mechanics, and quantum mechanics. (See the Physics and Astronomy listing for information about enrolling through that department.) Students’ oral qualifying exams include topics in Physics, and their dissertation committees include at least one member of Physics and Astronomy.

**Admission Requirements**
All programs require letters of recommendation and personal statements. All except Art Education require GRE general test scores; these are waived for current and recent Tufts undergraduates.

Art education applicants submit a portfolio to the School of the Museum of Fine Arts. Applicants seeking licensure as teachers of French, German, Spanish, or other languages submit a writing sample in the language of specialization and complete an interview in that language. School psychology candidates must have completed course work in personality or developmental psychology, abnormal psychology, and statistics and should have experience in a human services setting or with children and adolescents in other settings. Ph.D. applicants submit writing samples of their scholarly work.

For more information or to apply, please see [gradstudy.tufts.edu/admissions](http://gradstudy.tufts.edu/admissions).

**Massachusetts Tests for Educator Licensure**
Students who plan to teach in Massachusetts must pass the Massachusetts Tests for Educator Licensure (MTEL) required for the area in which they wish to be licensed. Students who wish to be licensed as school psychologists in Massachusetts must pass the communication and literacy portion of the MTEL. The department offers information sessions, study guides, and tutoring as needed in preparation for these exams.
Electrical and Computer Engineering

Professor Eric L. Miller, Chair; Signal processing, image processing
Professor Mohammed Nurul Afsar, Microwaves, design and measurements
Professor Jeffrey A. Hopwood, Microelectronics, plasma engineering
Professor Karen Panetta, Simulation, multimedia
Professor Douglas Preis, Electromagnetics, signal processing, audio engineering
Professor Aleksandar Stančković, Alvin H. Howell Professor in Electrical Engineering; Energy processing systems, control and estimation
Associate Professor Chorng Hwa Chang, Computer engineering, communication networks
Associate Professor Mark Hempstead, Computer architecture
Associate Professor Valencia J. Koomson, High-speed/low-noise integrated circuits for optical RF communications, optoelectronic VLSI
Associate Professor Tom Vandervelde, Optoelectronic materials, thermophotovoltaics, photovoltaics
Associate Professor Mai Vu, Network information theory, energy-efficient and wireless communications, signal processing
Associate Professor Sameer Sonkusale, Mixed-signal VLSI design, sensor electronics
Assistant Professor Shuchin Aeron, Statistical signal processing in sensor networks, network information theory
Assistant Professor Usman Khan, Signal processing and control, graph theory
Professor of the Practice Ronald Lasser, Product development and innovation management
Professor of the Practice Brian Tracey, Signal processing, image processing, acoustics
Research Assistant Professor Kevin Grossklaus, Optoelectronics, Thin film deposition, Energy materials, Materials characterization, III-V semiconductors
Research Assistant Professor Alan Hoskinson, Plasma physics, electromagnetics, chemical sensors

SECONDARY APPOINTMENTS:
Professor Sergio Fantini, Biomedical Engineering; Biomedical instrumentation, medical optics, near infrared imaging of the brain, optical mammography
Professor Mark Cronin-Golomb, Biomedical Engineering; Optical instrumentation, laser tweezers, atomic force microscopy, nonlinear optics
Professor Soha Hassoun, Computer Science; CAD, VLSI design
Professor William Messner, Mechanical Engineering; Automatic control systems with an emphasis on applications to data storage systems, robotics, microfluidics, and biological systems and instrumentation
Professor Fiorenzo Omenetto, Biomedical Engineering; Ultrafast nonlinear optics, nanophotonics, biopolymer multifunctional materials, photonic crystals, photonic crystal fibers
Associate Professor Alva Couch, Computer Science; Parallel computing, computer graphics
Associate Professor Jason Rife, Mechanical Engineering; Navigation, robotics, controls

The Electrical and Computer Engineering Department educates tomorrow’s technical leaders. Our students and faculty invent and design the electrical and electronic systems, optoelectronic materials, computational platforms, mathematical algorithms, and communications networks used throughout our society.

The department offers degree programs in electrical engineering and computer engineering for students in the School of Engineering. Minors in music engineering, computer science, engineering management, entrepreneurial leadership, and multimedia arts are also available for ECE students.

Electrical engineers apply concepts from physics and mathematics to create useful electrical devices and systems. Some examples of engineered electrical systems include communications systems, power generation, integrated circuits and electronics, fiber optic data transmission, medical image processing, and radar. The computer engineer designs devices and systems for the management of information in digital form, such as audio and video systems, microprocessor control systems, digital communications, and computer networks. As software is as crucial to robust design as hardware, the computer engineer is also a knowledgeable programmer.

The department teaches courses in digital circuits and systems, microelectronics and very large-scale integrated circuit design, computer architecture, circuits, linear systems, signal and image processing, microwaves and microwave devices, electronic materials and solar cells, power and energy systems, communications, and control. Design is integral to all of our engineering degree programs, each of which culminates in a senior design project.

By careful selection of course work, students who follow the standard curricula listed below may also
satisfy admission requirements for professional schools of medicine, dentistry, business, or law.

UNDERGRADUATE PROGRAMS

The mission of the Department of Electrical and Computer Engineering is to provide our students with educational experiences that give them a sound basis for professional practice, advanced education, active citizenship, and lifelong learning. At its core is the goal that students learn the fundamental principles of electrical and computer engineering and master engineering methods to solve challenging and diverse problems. Further, the department strives to have each student develop the leadership and communications skills necessary to relate these solutions to both technical and non-technical communities. The faculty is dedicated to accomplishing this mission through the integration of teaching and research.

Bachelor of Science in Electrical Engineering

The accredited curriculum leading to the degree of Bachelor of Science in electrical engineering is intended to qualify students to begin a professional career in electrical engineering or to proceed to advanced study. The departmental concentration electives and free electives permit the undergraduate to select additional courses in a range of specialized areas. Students may study a wide variety of topics, including sustainable energy systems, semiconductor integrated circuits, VLSI design, biomedical engineering, microwaves and telecommunications, antennas and antenna systems, digital signal and image processing, control systems, communications and information theory, semiconductor and optoelectronics materials, power electronics and power systems, computer architecture, parallel processing, computer systems, and multimedia.

The core courses of the degree program contain elements of design as well as analysis, and include associated laboratory work. They involve concepts of circuits, signals, and systems, digital and analog electronics, microprocessors, electromagnetic fields, automatic control and communication.

The objectives of the Electrical Engineering program are:

• The EE graduate will demonstrated a professional impact in her/his employment or graduate work.
• The EE graduate will be a leader among his/her peers or a leader in innovation.
• The EE graduate’s work product will reflect a concern for others.

The program leading to this degree is accredited by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET). The required courses for the electrical engineering program are listed below. They are presented in one of many possible arrangements for completing the program. Of the 38 course credits required for the professional degrees accredited by the Engineering Accreditation Commission of ABET, a minimum of 9.5 course credits must be completed in college level math and basic science subjects appropriate to the discipline, and a minimum of 14.5 course credits must be completed in engineering topics, consistent with ABET general and program criteria.

First Year
FALL TERM
Engineering Introduction 93
Mathematics 32
Physics 11 with lab
English 1

SPRING TERM
Engineering Science 2
Mathematics 36
Physics 12 with Lab
Humanities, arts, or social sciences elective

Sophomore Year
FALL TERM
Engineering Science 3 Introduction to Electrical Systems
Mathematics 42
Mathematics 70 or 72
Chemistry 1 or 16
Humanities, arts, or social sciences elective
Bachelor of Science in Computer Engineering

In both required and elective courses throughout the curriculum, computer analysis is used extensively in the study of electrical systems, components, and materials. Students wishing to investigate the analysis and design of digital computers more intensively, as well as the analysis, design, and operation of systems in which computers are an integral part, may follow the Computer Engineering program.

The objectives of the Computer Engineering program are:

• The CompE graduate will demonstrated a professional impact in her/his employment or graduate work.
• The CompE graduate will be a leader among his/her peers or a leader in innovation.
• The CompE graduate’s work product will reflect a concern for others.

The program leading to this degree is accredited by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET). The required courses for the computer-engineering program are listed below. They are presented in one possible arrangement for completing the program. Of the 38 course credits required for the professional degrees accredited by the Engineering Accreditation Commission of ABET, a minimum of 9.5 course credits must be completed in college level math and basic science subjects appropriate to the discipline, and a minimum of 14.5 course credits must be completed in engineering topics, consistent with ABET general and program criteria.
First Year
FALL TERM
Engineering Introduction 93
Mathematics 32
Physics 11 with Lab
English 1

SPRING TERM
Engineering Science 2
Mathematics 36
Physics 12 or Chemistry 1
Humanities, arts, or social sciences elective

Sophomore Year
FALL TERM
Engineering Science 3 Introduction to Electrical Systems
Mathematics 70 or 72
Mathematics 42
Physics 12 or Chemistry 1
Humanities, arts, or social sciences elective

SPRING TERM
Engineering Science 4 Introduction to Digital Logic Circuits
Electrical Engineering 21 Electronics I with Lab
Mathematics 51
Computer Science 11 Introduction to Computer Science
Humanities, arts, or social sciences elective

Junior Year
FALL TERM
Electrical Engineering 14 Microprocessor Architecture and Applications
Electrical Engineering 23 Linear Systems
Computer Science 15 Data Structures
Mathematics 61
Free elective

SPRING TERM
Electrical Engineering 18 Electromagnetic Waves
Electrical Engineering 26 Digital Logic Systems
Electrical Engineering 31 Junior Design Project
Electrical Engineering 104, Probabilistic Systems Analysis
Humanities, arts, or social sciences elective

Senior Year
FALL TERM
Electrical Engineering 97 Senior Design Project (half credit)
Electrical Engineering 103 Introduction to VLSI Design
Electrical Engineering 126 Computer Engineering
Electrical Engineering 128 Operating Systems
Natural sciences elective
Computer engineering elective*

SPRING TERM
Electrical Engineering 98 Senior Design Project (half credit)
Computer engineering concentration elective*
Computer engineering concentration elective*
Humanities, arts, or social sciences elective

*Computer engineering electives are selected from a list provided by the department. The selections are subject to the approval of the departmental advisor.

Bachelor of Science in Engineering Physics

The Department of Electrical and Computer Engineering, in cooperation with the Department of Physics, offers a combined program of study leading to a bachelor of science in engineering physics. The program combines an emphasis on the mastery of the fundamental principles of physics and basic mathematical techniques with the disciplined practicality of professional engineering. Students enrolled in this program are members of the School of Engineering but will have academic advisors in both engineering and physics. While a student may enter the engineering physics program at any time, it is expected that he or she will have taken the introductory courses in basic science and mathematics common to all Tufts engineering programs. Early participation in faculty research projects is encouraged.

The program leading to this degree is not accredited by the Engineering Accreditation Commission (EAC) of ABET, Inc.

UNDERGRADUATE MINOR PROGRAMS
(See disciplinary minor programs for restrictions.)

Computer Science

The department offers a minor in computer science for those students pursuing the B.S.E.E. or B.S.C.P.E. degree. Details are available from the Department of Computer Science.

Engineering Management

The Engineering Management minor is a leadership-focused course of study that emphasizes real-life experience and engineering practice. The minor is available to students in the School of Engineering. Details are available from the Tufts Gordon Institute.

Entrepreneurial Leadership

The Entrepreneurial Leadership Program provides hands-on educational opportunities for students interested in founding their own companies or working in entrepreneurial environments. The minor is open to all Tufts Arts and Sciences and School of Engineering students. Details are available from the Tufts Gordon Institute.

Music Engineering

The minor in Music Engineering provides students with experiences at the intersection of music and technology. Students learn the technologies behind music-making, both traditional and modern, and how new technologies can be applied to musical goals. The minor is available to students in both the School of Engineering and the School of Arts and Sciences.

Multimedia Arts

This interdisciplinary minor is offered through the Communications and Media Studies program. For specific information about the policies governing requirements and electives, visit http://ase.tufts.edu/cms/mma.html.

Certificate Program in Microwave and Wireless Engineering

The department offers a graduate-level certificate in microwave and wireless engineering. The certificate is offered on a part-time, non-degree basis for students seeking professional training. In most cases, courses taken in a certificate program can be transferred into a graduate degree program. For more information, see Microwave and Wireless Engineering in this bulletin, contact the program administrator, Angela Foss, at angela.foss@tufts.edu or 617-627-2320, or visit http://gradstudy.tufts.edu/programs/certificates.

The certificate requires five courses.

Two required courses:
EE 107 Communications Systems I
EE 117 Introduction to Microwave Devices
One or both of the following:

EE 118 Microwave Semiconductor Devices and Circuits
EE 160 Computer-Aided Design of Microwave Circuits

Two graduate-level elective courses in microwave engineering or related fields:

EE 108 Communications Systems II
EE 136 Antennas for Radar, Avionics, and Communications
EE 137 Radar Engineering
EE 148 Silicon Radio Frequency IC Design
EE 161 Microwave Integrated Circuits
EE 193SBC Satellite-Based Communications
EE 194W Wireless Communications
EE 127 Information Theory

Students may substitute other Tufts graduate courses, subject to the approval of the certificate faculty advisor.

GRADUATE PROGRAM

Master of Science

The department offers a program leading to the M.S. degree in electrical engineering. The Master of Science degree requires ten credits, usually one credit per course, and all courses must be at the 100 level or above. For full-time students, one credit must be the Electrical Engineering Seminar. Students wishing for their MS degree to have the designation of “with thesis” must undertake a two-credit thesis course. This course takes the form of a creative thesis work, written and defended orally, and performed under the supervision of a faculty member. Grades in all courses must be B- or better.

The ECE department also offers a specialized Signals and Systems track within the M.S. degree in Biomedical Engineering. This track educates biotechnology engineers in (1) analysis and processing of signals with an emphasis on biomedical image processing and image formation and (2) design, control and synthesis of systems for biotechnology, e.g., development of miniaturized devices, circuits and systems, or controller design for bioreactors.

Doctor of Philosophy

The department offers a program leading to the Ph.D. in electrical engineering. Students in the program must already have a Bachelor’s of Science degree in electrical and computer engineering or a related field. High achieving applicants to the Ph.D. program who do not have the M.S. degree may be considered for admission to the direct-to-PhD program. This is an accelerated program for advanced students who are deemed able to handle the rigors of PhD research with a lower requirement for introductory coursework. Applicants without a M.S. degree who are not accepted into the Direct-to-PhD program are automatically considered for admission as an M.S./Ph.D. student, where they will be expected to complete the Master of Science degree program, and on completion of that program will be considered for admission to the Ph.D. program.

The department differentiates between admission to the Ph.D. program and Ph.D. candidacy. No students are accepted as formal doctoral candidates until they (a) have exhibited merit in a qualifying examination process and (b) have identified a faculty member who has agreed to be their dissertation supervisor. The qualifying examination is comprised of a written examination that must be taken within one academic year of admission to the Ph.D. program, within two academic years for part-time students.

Doctoral candidates are expected to plan a program of research under the direction of their dissertation supervisor and with the guidance of a faculty research-committee. On completion of this research, the candidate must prepare and publicly defend a dissertation.

Ph.D. students in electrical engineering must take at least eighteen credits beyond the M.S. degree. These credits include a minimum of six credits of lecture-based class work, two credits of Electrical Engineering Seminar, and a dissertation. The dissertation effort is usually assigned ten credits. At least one credit of class-based course work must be taken from outside the field of electrical and computer engineering.

M.S./Ph.D. students are required to fulfill all of the requirements of both the M.S. and PhD programs, a full 28 credits. Students in the Direct-to-PhD program have a reduced credit requirement of 23 credits. Direct-to-PhD students need to complete ten credits of lecture-based class work, one additional lecture-based class credit from outside of the department, two credits of Electrical Engineering Seminar, and 10 disserta-
Typical areas available for dissertations include solid-state materials with an emphasis on optoelectronic and solar energy applications, microwave devices and systems, power systems and control, electromagnetics, antennas, plasma engineering, signal and image processing, VLSI and mixed-analog integrated circuits, microprocessor applications, computer architecture, communication systems, information theory, computer and wireless networks, and power electronics.

For detailed information, please visit the website http://www.ece.tufts.edu.
Engineering Education/Center for Engineering Education and Outreach

CO-DIRECTORS:
Professor Chris Rogers, Mechanical engineering
Professor David Hammer, Education and physics

ASSOCIATE DIRECTOR:
Merredith Portsmore

CORE FACULTY:
Research Assistant Professor Ethan Danahy, Director of Engineering Research; Computer science
Assistant Professor R. Benjamin Shapiro, McDonnell Family Professor of Engineering Education; Computer science and education

The Center for Engineering Educational Outreach has three main areas of interest: research in engineering education, outreach to the local and global community of teachers, and educational tool development. It is best known for its work with the LEGO Group in developing ROBOLAB, the educational version of LEGO Robotics. Over 60 engineering undergraduates work with the Center every semester to go into local classrooms to help teachers bring engineering to their class.

ENGINEERING EDUCATION MINOR
In the fall of 2009, the Tufts School of Engineering approved the Engineering Education minor program. The Engineering Education minor provides students with hands-on teaching experience through the Student Teacher Outreach Mentorship Program (STOMP). Engineering students participating in STOMP visit local K–12 classrooms once a week to facilitate hands-on engineering lessons, and gain a first-hand perspective on the challenges faced by educators today.

The Engineering Education minor not only provides students with STOMP field experience, but also provides an educational foundation that will help them in their classroom visits and influence their work.

Engineering students are encouraged to obtain an Engineering Education minor if they have:
• a passion for K–12 education, but don’t necessarily want to pursue a career in the field;
• a potential desire to go into the education field post-graduation, but want to explore the possibility first;
• a determination to become an educator post-graduation, and the minor experience will adequately prepare then in pursuing an M.A.T.;
• a need to be active in citizenship and public service pre- and post-graduation.

This minor is currently only open to Tufts engineering undergraduates. Students are eligible for the minor if they take five credits and participate in one field experience activity in the form of STOMP (http://www.stompnetwork.org) or an equivalent Education field course. The five required credits are divided among the three categories of Build, Apply, and Integrate.

If you are a Tufts Engineering student interested in the minor, please contact merredith.portsmore@tufts.edu with questions.

Master of Arts in Teaching Engineering (M.A.T)
Tufts University Graduate School of Arts and Sciences and the Tufts University School of Engineering are proud to announce the new Master of Arts in Teaching (M.A.T.) Engineering program, which will prepare teachers for teaching engineering. Engineering has become an essential component of STEM disciplines at the middle and high school levels. There is a clear need to prepare engineering teachers who have a strong academic background in engineering as well as a research-based understanding of how students learn the concepts and design process of engineering. Engineering teachers must also have an intellectual appreciation for the ways in which mathematics and science fields intersect with engineering.

Established in 2010, the M.A.T. in Engineering was generated out of the generous support of the Kodosky Foundation as a part of a gift to Prepare Engineers as Teachers (PET). The M.A.T. in Engineering is a unique program that breaks new ground in preparing engineers as teachers in Massachusetts. Candidates in the program will undergo an authentic interdisciplinary experience working with faculty, staff, and students.
in the Graduate School of Arts and Sciences and the School of Engineering.

The program builds on the successful teacher preparation programs of the Tufts Department of Education and the successful collaborations the department has had with development of engineering curriculum and STEM outreach in the Tufts School of Engineering, in particular the work of the Center for Engineering Education and Outreach (CEEO). The program is designed to create a deeply reflective, intellectual culture of considering engineering in schools that bridges the traditional tensions between research and practice in teacher preparation.

Candidates enroll in our programs to become middle or high school teachers who understand the importance of education in preparing an active, civically engaged citizenry and who know how to approach new ideas and challenges, such as how to implement standards-based education in an inclusive classroom.

The program leading to licensure endeavors to foster democratic dialogue, vitality, and change. In this way the program reflects a vision of hope and promise for educational change in the communities with whom we place pre-service teachers to practice the skills and competencies of their prospective profession.

The Tufts M.A.T. Program leading to licensure for middle and high school teaching is ordinarily completed within one academic year and two summer semesters, but candidates may choose to extend their studies and practicum experience for a longer period of time. The candidate typically completes two summer semesters and one full academic year in a thoughtful scope and sequence of academic course work and field experiences. The field experiences are the focus of the Fall and Spring semesters; courses and field experiences are closely aligned with each other, and experienced mentors as well as university supervisors provide valuable feedback and expertise. The summer semesters are focused on academic work in the discipline for which licensure is sought and in foundations and history of educational theory. Each candidate will have an advisor in Education as well as an advisor from the School of Engineering.

Please contact Brian Gravel (brian.gravel@tufts.edu or 617-627-4201) for more information about the program, applying, or financial aid.

Research in K–16 Engineering Education

Graduate-level research in engineering education can be pursued through the Department of Education’s STEM Education program or through CEEO-affiliated faculty in the School of Engineering.

Please contact Merredith Portsmore (merredith.portsmore@tufts.edu) for more information.
Engineering and Innovation Management/Gordon Institute

The Gordon Institute offers programs focused on engineering leadership, innovation, and entrepreneurship that provide graduate and undergraduate students with the tools they need to advance their careers, inspire teams, and bring innovative products to market. Please note that information on the Entrepreneurial Leadership Program can be found in the Entrepreneurial Leadership section of this bulletin.

PROGRAM DIRECTOR, Engineering Management Programs
Professor of the Practice Mary Adams Viola, Leadership, new product development, innovation, technology strategy

PROGRAM DIRECTOR, M.S. in Innovation and Management Program
Professor of the Practice Kevin Oye, Business strategy, new product introduction

CORE FACULTY:
Lecturer Alicia Amaral, Financial and managerial accounting
Lecturer Frank Apeseche, Financial and managerial accounting
Lecturer Mark Bamford, Conflict resolution
Lecturer Jennifer Braggin, Engineering management
Lecturer Jerome Brightman, Leadership
Lecturer Gerald Brown, Continuous quality improvement and supply chain management
Lecturer Gavin Finn, Engineering management, new product development
Lecturer Steve Geary, Supply chain management
Professor of the Practice Partha Ghosh, Multinational strategies
Lecturer Victoria Godfrey, Marketing
Lecturer Richard Goode, Sustainability
Senior Lecturer Amy Hirschfeld, Technical and managerial communication
Lecturer Sergei Ikovenko, Systematic innovation
Lecturer Stacy Lennon, Conflict resolution, leadership
Professor of the Practice Samuel Liggero, New product development, technology strategy
Lecturer Bob Murray, Business strategy
Lecturer James Nash, Project management and process improvement, quantitative systems
Lecturer Monica Pheifer, Engineering management
Lecturer Kishore Pochampally, Quantitative systems and operations management
Lecturer Debra Reich, Experience Design
Lecturer Annette Sawyer, Leadership, ethics
Lecturer Jane Seminara, Humanistic perspectives on leadership, ethics
Lecturer Louise Strayhorn, Leadership
Lecturer Abbott Weiss, Supply chain management
Lecturer Ewa Winston, Humanistic perspectives on leadership, ethics

UNDERGRADUATE PROGRAM
The Gordon Institute offers a minor in engineering management that is available to all engineering undergraduate students at Tufts. The program emphasizes real-life experience and engineering practice, not just theory. A Tufts engineering degree combined with an engineering management minor provides students with a competitive edge and equips them to make significant contributions as soon as they enter the workplace.

Five courses are required for the minor. All five courses in the minor must be taken for a grade. Four are designated:

EM 051 Engineering Management
EM 052 Technical and Managerial Communications
EM 153 Management of Innovation (ELS101 may be substituted for EM153.)
EM 054 Engineering Leadership (or ELS 107 with permission)

One course must be selected from the School of Engineering elective options or the general course elective options listed below. EM 52 and EM 54 are courses that can be used by engineering students to fulfill their
Social Science distribution requirements.

School of Engineering elective options:

EC5 – Principles of Economics
EM155 – Financial Management in High Technology Firms
Comp171 – Human Computer Interaction
Comp180 – Software Engineering
ME102 – Inventive Design
ENP161 – Human Factor Product Design
ME108 – Modern Quality Control
ES152 – Engineering Systems: Stochastic Models
ES56 – Probability and Statistics
CEE53 – Engineering Economics
CE185 – Legal Issues in Engineering
CBE110 – Introduction to Optimization

General course elective options:

EC 3 Principles of Accounting (free elective)
EC 5 Principles of Economics
PS 104 Public Administration (free elective)
PSY 17 Industrial and Organizational Psychology (social science elective)
SOC 122 Organizational Behavior (free elective)
ELS 103, ELS 105, ELS 107 (social science elective) (note: ELS 107 only as alternate to EM 054, Engineering Leadership, with permission)
DR 0027 Public Speaking (humanities elective)
PSY 0006 Psychology of Leadership (free elective) (note: PSY 0006 only as alternate to EM 054, Engineering Leadership, with permission)
PSY 53 Engineering Psychology (free elective)
SOC 114 Sociology of Leadership (social science elective)

GRADUATE PROGRAMS
The Gordon Institute specializes in transforming individuals with STEM backgrounds (science, technology, engineering, and math) into impactful leaders, innovators, and entrepreneurs. The Institute’s close ties with organizations in industry and government provide unique opportunities for experience-based learning and networking. Dedicated faculty with extensive real-world experience center their teaching approach on tangible career progress for students. The Gordon Institute offers two accredited graduate degree programs: a two-year M.S. in Engineering Management (M.S.E.M.) and a one-year M.S. in Innovation Management (M.S.I.M.).

The M.S.E.M. is a two-year, part-time program for working professionals that maps directly to students’ professional challenges and allows them to apply their learning on the job. The curriculum includes interactive classes and immersive consulting projects with start-up and established companies. Technical topics such as project management, product development, and quantitative methods are studied along with the broader areas of business management, leadership, and the humanities. This multidisciplinary approach fully prepares individuals in the global science and technology sector to advance their industries – and their careers. The program is offered in Evening, Saturday and Weekend formats to accommodate the needs of working professionals.

The M.S.I.M is a one-year, full-time program that prepares recent college graduates to have early-career impact and long-term success in the innovation economy. Program coursework and projects build on students’ technical foundation with an emphasis on innovation and entrepreneurship. Students develop fluency in the language of business; hone their ability to creatively synthesize novel new solutions to complex problems; and develop the leadership skills needed to influence, negotiate and build effective teams. Specialty track options allow students to customize the program to fit their unique goals, and a summer internship and substantive career workshops prepare students to successfully launch their careers.

For more detailed information, please visit the website http://gordon.tufts.edu.
Engineering Physics

(FOR DEGREE REQUIREMENTS, SEE PHYSICS and astronomy.)
Engineering Psychology/Human Factors Engineering

DIRECTOR OF THE UNDERGRADUATE PROGRAM IN HUMAN FACTORS ENGINEERING:
Professor of the Practice Daniel J. Hannon, Mechanical Engineering

UNDERGRADUATE ADVISOR FOR LIBERAL ARTS:
Professor Holly Taylor, Psychology

AFFILIATED FACULTY:
Professor of the Practice Daniel J. Hannon, Mechanical Engineering
Professor Holly A. Taylor, Psychology
Professor of the Practice Michael Wiklund, Mechanical Engineering

The Engineering Psychology/Human Factors Engineering program is an interdisciplinary program offered jointly by the departments of mechanical engineering and psychology.

Engineering psychology, more commonly called human factors, applies knowledge of human behavior and attributes to the design of products, equipment, machines, and large-scale systems for human use. Areas of application include medical devices and systems design, transportation safety, consumer product design, and computer interface design. Students in the School of Engineering or the College of Liberal Arts will receive the bachelor of science degree from their respective colleges after meeting the general requirements set by each college.

The program prepares students for professional work and further graduate studies in this discipline. It also serves as a preparation for premedical and pre-dental students; and for those interested in careers in technology design and development, or management.

UNDERGRADUATE CONCENTRATION REQUIREMENTS
The program features fourteen courses divided into introductory and core course requirements, with specific subsets for students in the College of Liberal Arts and the School of Engineering. For engineering students, an additional twenty-two courses are required for the bachelor of science degree (see School of Engineering information). For liberal arts students, an additional twenty courses are required to meet the foundation and distribution requirements for the bachelor of science degree (see College of Liberal Arts information). The core courses can be used by these students to meet the social and natural science distribution requirements (see the online course catalog on iSIS for course descriptions).

Introductory course requirements:
Engineering Science 2 Introduction to Computing in Engineering
Psychology 1* or Psychology 9 Introduction to Psychology or Introduction to Cognitive and Brain Sciences

*Only Psychology 1 is approved for students in the School of Engineering; students with Advanced Placement Credit for Psychology 1 should take Psychology 9.

Required for students in the College of Liberal Arts:
Engineering Science 18 Computer-Aided Design with Lab (1 credit)
Computer Science 11 or Physics 11 Introduction to Computer Science or General Physics I
Computer Science 15, Math 32, or Math 61 Data Structures, Calculus I, or Discrete Math

or

Required for students in the School of Engineering:
Introduction to Engineering 1
Computer Science 11 Introduction to Computer Science
Core course requirements:

**Computer Science 15** Data Structures

**Engineering Psychology 61** Introduction to Human Factors and Ergonomics
**Engineering Psychology 120** Project Study in Human Systems (year-long capstone course)
**Engineering Psychology 161** Human Factors in Product Design
**Engineering Psychology 162** Human-Machine System Design
**Psychology 17** Industrial and Organizational Psychology
**Psychology 31** Behavioral Statistics
**Psychology 32** Experimental Psychology
**Psychology 53** Engineering Psychology
**Psychology 130** Advanced Engineering Psychology

In addition to these courses, students in the College of Liberal Arts will take one Psychology elective, and it is recommended they consider taking the following courses with particular relevance to the field of Engineering Psychology: Engineering Science 5, Psychology 107, Computer Science 15, Computer Science 086 or 171, and Engineering Psychology 166.

Students enrolled in the School of Engineering must also satisfy the following distribution requirements for the Engineering Psychology Program: Mathematics 32 and 36, Engineering Science 3 or 5, Engineering Psychology 166, Computer Science 171, Mechanical Engineering 108 or Psychology 31, English 1 or 3, Psychology 107, Engineering Management 52, one approved Engineering elective, one approved Mathematics elective, two approved Natural Science electives, two approved Humanities/Arts and Social Science (HASS) electives, one approved Computer Science elective, and four approved concentration electives. There are two free electives as well. Independent study and student thesis opportunities are available.

Students enrolled in the School of Engineering with an anticipated graduation of 2020 or beyond must also satisfy the following distribution requirements for the Engineering Psychology Program: Mathematics 32 and 34 or 36, Engineering Science 3 or 5, Engineering Psychology 166, Computer Science 171, Psychology 31, English 1 or 3, Psychology 107 or ME108, Engineering Management 52, one approved Engineering elective, one approved Mathematics elective, two approved Natural Science electives, three approved Humanities/Arts and Social Science (HASS) electives, one approved Computer Science elective, and three approved foundation electives. There are two free electives as well. Independent study and student thesis opportunities are available.

Sample course plans can be obtained from either of the sponsoring departments.
The Department of English offers a wide range of courses in British, American, and world literatures in English; film; literary theory; and creative writing. Though diverse, these offerings are unified by the study of textual production and the styles and practices of writing in English. Courses in the department examine literary works in their most illuminating contexts: historical, social, philosophical, and political. The department’s courses in expository and creative writing enable students to refine their skills through reading, frequent writing assignments, and discussion.

The department serves the interests of students who plan to become teachers or writers of literature, as well as those preparing for other professions that put a high premium on cultural analysis, effective writing, symbolic interpretation, or media studies. Among the fields our students commonly enter are law, diplomacy, journalism, public relations, publishing, teaching, and filmmaking. Students who have majored (or double-majored) in English are also seen as especially attractive candidates by medical, law, and business schools. Our courses are central to a liberal arts education, regardless of anticipated career, because they instill a mastery of critical thinking, linguistic analysis, and persuasive communication in a world that increasingly demands that we not only read but also read through the representations that we encounter.

UNDERGRADUATE CONCENTRATION REQUIREMENTS

English majors work out a sequence of courses in consultation with their advisors. A list of approved courses for each category is available online through the English department website: [http://ase.tufts.edu/english](http://ase.tufts.edu/english).

Students must take ten courses listed or cross-listed in the department above English 1, 2, 3, and 4 as follows.

1) One survey course from the following:

- **English 20** Black World Literature (formerly English 36)
- **English 21** General View of English Literature I (formerly English 51)
- **English 22** General View of English Literature II (formerly English 52)
- **English 23** American Literature: First Contact to 1855 (formerly English 59)

2) Two non-survey classes in American, British, or other Anglophone literature written before 1860, including at least one course in British literature. No more than one course used to fulfill this part of the requirement may be on Shakespeare. A list of approved courses for this category is available at this link: [http://ase.tufts.edu/english/undergraduate/majorsApprovedCourses.htm](http://ase.tufts.edu/english/undergraduate/majorsApprovedCourses.htm).

3) Two non-survey courses in American, British, or Anglophone literature written after 1860. A list of approved courses for this category is available at this link: [http://ase.tufts.edu/english/undergraduate/majorsApprovedCourses.htm](http://ase.tufts.edu/english/undergraduate/majorsApprovedCourses.htm).
4) Five remaining courses of the student’s choice from the department’s listings. See course listings by semester at this link: http://ase.tufts.edu/english/courses.

In constructing their majors, students are expected to work with their advisors to design a coherent but wide-ranging course of study. English majors should take survey courses early in their academic career in order to establish the necessary foundation for more advanced classes. We encourage all students majoring in English to explore the full historical range of offerings; to investigate the spectrum of textual differences to be found in the study of Anglophone literatures, film, and oral traditions; and to include exposure to recent approaches in English studies, such as women’s studies, literary theory, historical materialism, and cultural studies. With the help of their advisors, English majors should seek to create programs of study that expand their knowledge and challenge their preconceptions.

No more than four transfer courses may count toward fulfillment of the major.

Students should be aware that they may count toward the major no more than two creative writing courses at the introductory level in each of the areas offered (i.e. Creative Writing: Fiction, Creative Writing: Poetry, and Creative Writing: Journalism) and no more than two intermediate level courses in each of those areas. There is no limit on the number of advanced creative writing courses a student may count. Nonfiction Writing and Intermediate Journalism may each be counted only once.

Students must receive a grade of C- or higher in any course that they wish to count toward the fulfillment of English major requirements.

UNDERGRADUATE MINOR PROGRAM
The minor in English requires students to take six courses in the department above English 1, 2, 3, and 4. The purpose of the minor is to allow students to experiment widely, or to follow a particular interest with some concentration. Therefore, each minor will be individual not only in content but also in concept. All students should try, however, to include at least one course numbered below 100 and one above 100 and should consult with faculty members as they pursue their minors. Students may count a maximum of three creative writing courses toward fulfillment of the minor in English. No more than two transfer courses may count toward fulfillment of the minor.

GRADUATE PROGRAM
The graduate program in English, American, and Anglophone world literature is varied and flexible. It offers special opportunities for literary analysis with a focus on cultural studies, literary theory, and topics in gender, race, and politics. Many of the department’s period, genre, and interdisciplinary courses lend themselves to a broadly conceived program in literature and culture, including interdisciplinary work. Approved courses in other departments may be taken to that end. Admission is in the Fall semester only.

More information can be found at this link: http://ase.tufts.edu/english/graduate.

Master of Arts
Master’s candidates are required to complete six semester courses, with the expectation that they will enroll in three graduate seminars per semester. Because doctoral degree candidates are required to take a comprehensive examination in their third year, students are advised to take courses that offer them breadth as well as depth. At the end of the master of arts year, they will take a written examination to demonstrate their critical and analytical skills. One month before the examination they will be assigned two texts to prepare. The examination will test their ability to integrate critical, theoretical, and contextual analyses of the texts.

At the end of the academic year, the full faculty will consider the master’s candidates individually, focusing on the results of their master’s examination, their academic records at Tufts, and the recommendations of the faculty who have taught them. On the basis of this appraisal, the department will recommend whether or not the candidate should be granted the master of arts; it will also determine whether or not the candidate should be admitted to candidacy in the doctoral degree program.

The required reading knowledge of a foreign language must be demonstrated to the satisfaction of the Graduate Committee (usually by an examination taken at Tufts University) in order to complete the requirements for the master of arts degree.

Doctor of Philosophy
Admission to the doctoral degree program is open to students who have completed with distinction the master’s degree in English, either at Tufts or another university. Students who enter with a master’s degree from
another institution will enroll in three graduate seminars per semester during their initial year. At the end of that year, their work will be reviewed by the faculty, who will determine whether each candidate should continue in the program; upon receiving a positive recommendation, candidates who came to Tufts with a master’s degree in hand will pass into the third-year program. Students who successfully complete the master’s degree at Tufts will enter the second year of the program, receiving mentoring as teaching assistants in both literature and composition courses while taking three courses each semester, one of which will be a proseminar offering training in various aspects of the profession.

During the second and third years, doctoral candidates will increase their comprehensive knowledge while beginning to concentrate on one particular area or subject. Normally, the courses they take will be chosen from among the graduate seminars in the department, but advanced-level undergraduate courses or independent studies may be counted with the approval of the director of graduate studies. During the third year of the program, all candidates will complete their coursework by taking two courses in the fall semester. At the same time, they will begin to teach one course per semester in the First-Year Writing Program; they will normally continue teaching through the fifth year.

At the end of the third year, each student will take a two-hour oral comprehensive examination. The examining committee will consist of three faculty members, one of whom, the chair, has been selected by the student as someone familiar with the student’s work in class. In most cases, the graduate student will already have spoken with this faculty member about serving as director of her or his dissertation.

No standardized list of texts is issued for this examination. The graduate program is small and one advantage of its size is that students’ individual interests can be accommodated. It is not the purpose of the examination to have everyone do the same thing. Instead, it seeks to test each student’s range and breadth of knowledge. Therefore, the following guideline of periods and areas of concentration is to be used by each student to generate a foundation list of works in each period or area for which he or she will be responsible. This list is not intended to be exhaustive or exclusive; not everything the student has read will show up on the list. Critical works on periods and texts will be included on each list. This list of specific titles should be arrived at in consultation with individual faculty members and with the director of the graduate program. The list must be submitted to the director of the graduate program in English at least three months before the oral examination.

Periods and areas of concentration for the doctoral degree comprehensive examination are

- Old English
- Medieval Literature
- Sixteenth-Century British Literature
- Seventeenth-Century British Literature
- Eighteenth-Century British Literature
- American Literature before 1820
- Nineteenth-Century British Literature
- Nineteenth-Century American Literature
- Twentieth-Century British Literature
- Twentieth-Century American Literature
- Contemporary World Literature
- Literary Critical Theory

Each candidate also has the option of constructing, in consultation with the chair of the committee, one special topic focused on his or her particular area of interest, in preparation for the dissertation. Candidates will select eight of the periods or areas for particular development for the comprehensive examination. Two of those fields will be fulfilled by course work completed in graduate school. The other six will be the focus of the comprehensive oral examination. Students who do not pass the oral examination, in whole or in part, may take the examination again at a later date.

Once the student has passed the oral comprehensive, he or she will produce a prospectus for the dissertation. This must be submitted to the department not later than six months after the oral examination.

In order to complete the doctoral degree, each student is required to demonstrate by examinations or courses taken at Tufts an ability to read two foreign languages (one of which was necessary in order to fulfill the requirements for the master of arts). Alternatively, doctoral candidates may complete with a passing grade at least one graduate level course in a foreign literature. It is generally expected that this course will be done in a body of literature relevant to the student’s graduate study.

Tufts in London
The Department of English cooperates with other departments in offering undergraduates a year of study in England. For more information, see Tufts Programs Abroad.

For more detailed information, please visit the website http://ase.tufts.edu/english.
Entrepreneurial Leadership Studies/Gordon Institute

DIRECTOR:
Senior Lecturer Inge Milde, *Entrepreneurship and business planning, field studies*

FACULTY:
Associate Dean & Executive Director TGI, *Professor of the Practice Mark Ranalli, Entrepreneurship and business planning, field studies*

Lecturer Alicia Amaral, *Entrepreneurial finance*
Lecturer Frank Apeseche, *Entrepreneurial finance*
Lecturer Eric Braun, *Entrepreneurship and business planning*
Lecturer Yumin Choi, *Entrepreneurial finance*
Lecturer Jack Derby, *Entrepreneurial marketing*
Lecturer Gavin Finn, *Entrepreneurial marketing*
Lecturer Peter Marton, *Entrepreneurial leadership*
Lecturer Pamela Stepp, *Entrepreneurial leadership*
Lecturer Joshua Wiesman, *High Technology Entrepreneurship, Creative Design Process of Products*
Lecturer Ambereen Mirza, *Innovative Social Enterprises*

The Entrepreneurial Leadership Studies Program at Tufts provides hands-on educational opportunities for students interested in founding their own companies or working in entrepreneurial environments. The program strives to engage students in the ever-changing world of new business ventures and teaches them to develop innovative, real-world solutions to business challenges.

The program attracts top faculty and continuously works to develop industry partnerships to provide students with internship and networking opportunities. Through our rigorous curriculum and connections to alumni in business and industry, the program strives to benefit both students and the corporate community. With access to outstanding teachers, intensive coursework, guest speakers, internships, and real-world business networks, our students develop the advanced knowledge they need to become the entrepreneurial leaders of the future.

A minor in entrepreneurial leadership is available for all arts, sciences, and engineering undergraduate and graduate students interested in leadership positions at start-up companies or entrepreneurial segments of the corporate or social sector. Students are required to take four courses plus one elective course from the lists below. All courses must be taken for a grade. Students will attend lectures, discuss relevant issues with guests from the real world, complete homework assignments, take tests, participate in focused discussions of relevant issues and current events, and complete a course project on a topic central to the theme of the course.

After meeting the necessary requirements for the minor, students complete the minor certification form and return it to the Gordon Institute.

Required courses:
ELS101 Entrepreneurship and Business Planning (may substitute ELS 101.03, EC 74,BME 194 or EM 153)
ELS103 Entrepreneurial Finance (may substitute EM 55)
ELS105 Entrepreneurial Marketing
ELS107 Entrepreneurial Leadership (may substitute EM 54)

Elective courses:
ELS 141 Innovative Social Enterprises (cross-listed as American Studies 141 and taught in partnership with Tisch College)
ELS 193, 194 Special Topics: Internship/Research
ELS 199 Entrepreneurial Field Studies: Launching the Venture
EC 3 Principles of Accounting
EC 6 Business Law
UEP 23 Negotiation, Mediation and Conflict Resolution
DR 10 Introduction to Acting
DR 27 Public Speaking
Annual Events
The Entrepreneurial Leadership Studies Program organizes two annual entrepreneurial speaking events: the Lyon and Bendheim Entrepreneurial Alumni Lecture Series and the Alan Shapiro Entrepreneurial Lecture Series.

$100k New Ventures Competition
The Entrepreneurial Leadership Studies Program manages the annual $100k New Ventures Competition. This university-wide event attracts entries from undergraduate and graduate students, researchers, faculty, staff and alumni from across the entire University including Arts and Sciences, School of Engineering, Sackler School of Graduate Biomedical Sciences, the Fletcher School of Law and Diplomacy, the Cummings School of Veterinary Medicine, Jonathan M. Tisch College of Citizenship and Public Service, the School of Dental Medicine, the School of Medicine, and partner School of the Museum of Fine Arts. The Tufts $100k New Ventures Competition uniquely positions itself with three competition tracks: Social Impact, Life Science, and General/High Tech.

Ideas Competition
The Tufts Ideas Competition provides early-stage startups with mentorship, funding and the support needed to catalyze their ideas and serve as a feeder for the $100k New Ventures Competition.

For more detailed information, please visit the website http://gordon.tufts.edu/entLeader.
Environmental Health

DIRECTOR:
Professor David M. Gute, Environmental and occupational epidemiology

CORE FACULTY:
Lecturer Anne Marie Desmarais, Risk assessment and toxicology
Assistant Professor Daniele S. Lantagne, Useen Family Career Development Assistant Professor, Public health engineering, global health, water-borne pathogens
Professor Kurt Pennell, Bernard M. Gordon Senior Faculty Fellow Groundwater remediation technologies, fate and transport of emerging contaminants, neurotoxicity of persistent organic pollutants and engineered nanomaterials
Senior Lecturer Mark Woodin, Epidemiology and biostatistics

ASSOCIATED ENVIRONMENTAL HEALTH FACULTY:
Adjunct Professor Douglas Brugge, Professor of Public Health and Community Medicine, Asthma, air pollution, environmental justice, immigrant health
Professor Steven C. Chapra, Water quality modeling and transport of pathogens
Associate Professor Wayne Chudyk, Drinking water quality and treatment
Associate Professor John L. Durant, Contaminant fate and transport
Adjunct Professor Jeffrey Griffiths, Professor of Public Health and Community Medicine, Infectious disease epidemiology, characterization of waterborne pathogens and global health
Adjunct Professor Elena N. Naumova, Biostatistics and infectious disease modeling
Associate Professor Christopher Swan, Site remediation

The Environmental Health program, which celebrated its 50th anniversary in 2014, is an interdisciplinary program based in the Department of Civil and Environmental Engineering of the School of Engineering. Historically, professional programs in environmental health were established in schools of engineering to promote research on control of infectious disease, purification of water supplies, and sanitary disposal of human wastes. Today, the focal points of Environmental Health at Tufts has broadened to such challenging issues as environmental pollution, epidemiological aspects of chronic illnesses, occupational health, community based participatory research (CBPR), primary prevention of water-borne disease, toxicology, and risk assessment and management.

While the program retains its traditional strength in environmental engineering, it also provides a sound background in epidemiology, biostatistics, occupational health, and toxicology. The problems and issues in environmental health can be viewed in three broad categories:

1) Biological: living organisms, ranging from food upon which life depends to pathogenic microorganisms responsible for disease.
2) Physical: nonliving things affecting people (physical agents such as heat, noise, radiation, consumer and industrial products, and chemical agents such as environmental pollutants and systemic poisons).
3) Social: the interrelationships within society, which include cultural values, customs, attitudes, economic status, and social-political organization.

The Environmental Health (EH) Graduate Program at Tufts University places emphasis on an interdisciplinary approach to understanding and solving current and classical environmental health problems as they manifest themselves in society. Students study environmental contaminants in air, water and land, the effects of occupational exposures to hazardous materials, risk and exposure assessment, toxicology, the epidemiological aspects of infectious and chronic diseases, the use of biostatistics in the description of the distribution of disease, and the applications of these context areas in the practice of environmental risk management in solving local and global environmental health problems.

Environmental Health at Tufts operates at the interface of the natural and built environments and has introduced the concept of Public Health Engineering, which is integrated in coursework and research. A course in Public Health Engineering is now offered through the EH faculty and is required for undergraduate students in the B.S. program in Environmental Engineering. Through this course, Tufts undergraduates understand the relationships between environmental engineering and public health. Research interests of the Tufts Environmental Health faculty and graduate students range from evaluating and understanding needs of immigrant workers in the neighborhoods surrounding Tufts to assessment and mitigation of water contami-
nation in resource-challenged environments in Ghana, Haiti, and India.

UNDERGRADUATE PROGRAM

Bachelor of Science in Engineering
The Department of Civil and Environmental Engineering offers a B.S.E. program in environmental health. (See Civil and Environmental Engineering for program description and requirements.)

GRADUATE PROGRAM

Master of Science in Environmental Health
Requirements:
1. Core Courses (four credits)
   - CEE 154 Principles of Epidemiology
   - CEE 167 Environmental Toxicology
   - CEE 158 Occupational and Environmental Health
   - CEE 194F Biostatistics

   All MS and Ph.D. students must also complete four semesters of CEE 292 - Graduate EH Seminar. This is a non-credit seminar that meets for one hour per week.

2. Thesis (two credits)—The M.S. thesis is the culmination of concentrated study in a specific area of research within environmental health. Thesis work contributes two course credits toward the M.S. degree (CEE-295 and CEE-296).

3. Electives (four credits)—All Environmental Health M.S. students take four electives. The following lists are not inclusive and students may take other courses after consulting with their advisors. Students are reminded that the focus of the M.S. program is to cultivate depth in the student’s area of interest and courses should be selected in order to provide this depth and to select courses that will enhance the M.S. thesis research experience.

   - CEE 113 Groundwater Hydrology
   - CEE 136 Air Pollution Control
   - CEE 143 Site Remediation
   - CEE 164 Epidemiological Methods
   - CEE 172 Fate and Transport of Environmental Contaminants
   - CEE 173 Health Effects and Risk Assessment
   - CEE 187 Geographic Information Systems
   - CEE 194A Introduction to Remote Sensing
   - CEE 194C Environmental Informatics
   - CEE 194E Field Methods for Global Health
   - CEE 194H Global Environmental Datasets
   - MPH 224 Infectious Disease Epidemiology
   - MPH 226 Cancer Epidemiology
   - MPH 240 Environmental Epidemiology
   - MPH 206 Intermediate Biostatistics: Regression Methods
   - MPH 220 Cardiovascular Epidemiology
   - MPH 222 Survey Research Methods & Data Management
   - CEE 241/MPH241 Biology of Water and Health
   - UEP 294B Chemicals, Health, and Environment

4. Supplemental Electives List—Other courses of interest to EH MS students include the following. Students may substitute one of these courses for any track elective with his or her advisor’s approval. This list is not all-inclusive, and students may take other courses with their advisor’s approval.

   - CEE 138 Hazardous Waste Treatment Technology
   - CEE 212 Chemical Principles for Environmental and Water Resources Engineering
   - CEE 213 Transport Principles for Environmental and Water Resources Engineering
   - CEE 214 Environmental and Water Resources Systems Engineering
   - CEE/UEP 207 Environmental Law
In addition, on a space-available basis, students may enroll in courses offered in the Master in Public Health (M.P.H.) degree program. These courses are generally held on the Health Sciences campus in Boston.

**Master of Engineering in Environmental Health**
The Master of Engineering (MEng) program in Environmental Health provides a practice-oriented alternative to the Master of Science degree program. It provides students with the opportunity to concentrate on courses in Environmental Health, with focus areas in Epidemiology, Occupational and Environmental Health, Biostatistics, and Risk Assessment. The Master of Engineering program, like the Master of Science program, provides an interdisciplinary approach to assessing classical and current environmental health problems and concerns. The program meets the needs of professionals who want to complete a Master’s degree and return to work in the private or public sectors. The MEng degree is well-suited to part-time study, with many courses offered in the early morning, late afternoon, or evening.

Requirements:

A. **Required Core Courses** (four courses required):
- CE 154 Principles of Epidemiology
- CE 158 Occupational and Environmental Health
- CE 167 Environmental Toxicology
- CEE 194F Biostatistics

B. **Environmental Health Electives** (four courses required): Students should choose courses that best meet their interests and desired educational goals. Students should work closely with their advisors to select courses that will provide the best educational experience. Four courses from the Environmental Health Elective List are required. Students may take a fifth course or may elect to complete a one-credit Masters project.

- CEE 113 Groundwater Hydrology
- CEE 136 Air Pollution Control
- CEE 138 Hazardous Waste Treatment Technology
- CEE 143 Site Remediation
- CEE 164 Epidemiological Methods
- CEE 172 Fate and Transport of Environmental Contaminants
- CEE 173 Health Effects and Risk Assessment
- CEE 187 Geographic Information Systems
- CEE 194A Introduction to Remote Sensing
- CEE 194C Environmental Informatics
- CEE 194E Field Methods for Global Health
- CEE 194H Global Environmental Datasets
- CEE 241/MPH 241 Biology of Water and Health
- MPH 224 Infectious Disease Epidemiology
- MPH 226 Cancer Epidemiology
- MPH 240 Environmental Epidemiology
- MPH 265 Intermediate Biostatistics: Regression Methods
- MPH 220 Cardiovascular Epidemiology
- MPH 222 Survey Research Methods & Data Management
- UEP 294B Chemicals, Health, and Environment

Students may choose other courses with the approval of their advisor.

C. **Environmental Management Elective(s)** (one course required): Students must choose one course from the Environmental Management Elective List. They may take an additional course from this list, the elective list in B, or they may elect to complete a one-credit Masters project.

- CEE/UEP 207 Environmental Law
- CEE/UEP 265 Corporate Management of Environmental Issues
D. Masters Project—Masters of Engineering students may elect to complete a one-credit Masters Project. Students who elect this option will take a total of nine courses, four core courses, four Environmental Health electives, and one Environmental Management elective. Although any student may choose to complete a project, this option may best serve working professionals who can evaluate and assess a practice-oriented problem from their professional experience. Students who elect to complete a project should discuss their topic with their advisor. MEng students electing to complete a project do not need a formal committee, but are encouraged to ask members of the faculty to read and comment on their final report. Completed projects are submitted to the student’s advisor; there is no formal presentation.

Ph.D. in Environmental Health

The requirements for the Ph.D. degree can be highly individualized depending on each student’s background when he or she matriculates as a Ph.D. student. Students normally take seven courses beyond the Master’s degree or 15 courses beyond the Bachelor’s degree. However, students matriculating with a Master’s degree in a field unrelated to Environmental Health, or whose academic background lacks specific areas within the Tufts EH Master’s curriculum, may be required to take additional courses. The Ph.D. student’s advisor is the final arbiter in determining his or her course requirements.

Requirements:
A. Core Courses (four credits)
CEE 154 Principles of Epidemiology
CEE 158 Occupational and Environmental Health
CEE 167 Environmental Toxicology
CEE 194F Biostatistics*

*Another biostatistics or environmental statistics course may be substituted with the permission of the student’s advisor.

Ph.D. students who have the equivalent of one of the core courses will not be required to retake the course and, with the guidance of his or her advisor, should select another course that will provide advanced knowledge of the subject matter.

All MS and Ph.D. students must also complete four semesters of CEE 292 - Graduate EH Seminar. This is a non-credit seminar that meets for one hour per week.

B. Electives—Ph.D. students will take between three and eleven electives, depending on whether they matriculate with a Master’s or Bachelor’s degree, and based on their prior academic experiences. Courses should be selected with the guidance of the academic advisor, and should provide a conduit for each student to focus on depth in one academic area. Ph.D. students may select electives from the list of M.S. electives and/or may select other courses with the approval of their advisors. The academic advisor is the final arbiter in determining the courses taken by his or her Ph.D. student.
Environmental managers in industry, government, and consulting know that changes in environmental compliance requirements can lead to challenges and opportunities. Complex regulations, emerging environmental technologies, international environmental treaties, and multinational corporate environmental programs will determine the direction that environmental managers must take in the future. The Certificate in Environmental Management provides students with the tools and techniques to understand the future of environmental management.

Students in this program take graduate-level courses offered by the Departments of Civil and Environmental Engineering and Urban and Environmental Policy to develop a five-course program that includes environmental technology, environmental health, and environmental policy. Students can take courses to enhance their knowledge for professional advancement, including life-cycle analysis, GIS, groundwater hydrology, hazardous waste treatment technology, epidemiology, toxicology, corporate environmental management, international health, and environmental law.

The program is open to students with a bachelor’s degree. Students should have undergraduate coursework in engineering or the natural and physical sciences, including mathematics.

This five-course, graduate-level certificate, offered through the Department of Civil and Environmental Engineering, is designed to be pursued on a part-time basis by professionals seeking advanced training or by students preparing to enter a master’s degree program. The program can also be completed full-time in one academic year. In most cases, all courses taken as a certificate student can be transferred into a master’s degree program in the Department of Civil and Environmental Engineering.

For more information, contact the program administrator, Angela Foss, at 617-627-2320 or visit the website http://engineering.tufts.edu/cee/graduate/certenviromanagement.htm.
Environmental Studies

PROGRAM DIRECTOR (on sabbatical leave in 2016-2017):
Professor Colin M. Orians, Biology and Environmental Studies

PROGRAM INTERIM DIRECTOR 2016-2017:
Professor Ujjayant Chakravorty, Economics and Environmental Studies

PROGRAM ASSISTANT DIRECTOR:
Dr. Sara Gomez, Environmental Studies

EXECUTIVE COMMITTEE:
Professor Ujjayant Chakravorty, Economics and Environmental Studies
Professor Jonathan E. Kenny, Chemistry
Professor J. Michael Reed, Biology
Professor Jack Ridge, Earth and Ocean Sciences
Professor Modhumita Roy, English
Associate Professor John Durant, Civil and Environmental Engineering
Assistant Professor Alexander Blanchette, Anthropology and Environmental Studies
Assistant Professor Andrew Kemp, Earth and Ocean Sciences and Environmental Studies
Assistant Professor Karen Kosinski, Community Health Program
Assistant Professor Benjamin Wolfe, Biology
Senior Lecturer Cathy Stanton, Anthropology
Lecturer Ann Rappaport, Urban and Environmental Policy and Planning
Lecturer Ninian Stein, Environmental Studies

ACADEMIC ADVISORS:
Professor Elizabeth Ammons, English
Professor Ujjayant Chakravorty, Economics and Environmental Studies
Professor Jonathan E. Kenny, Chemistry
Professor Colin M. Orians, Biology and Environmental Studies
Professor J. Michael Reed, Biology
Professor Jack Ridge, Earth and Ocean Sciences
Professor Modhumita Roy, English
Associate Professor John Durant, Civil and Environmental Engineering
Associate Professor George S. Ellmore, Draupner Ring Scholar; Biology
Associate Professor Patrick Forber, Philosophy
Associate Professor David Gute, Civil and Environmental Engineering
Associate Professor Jeanne Penvenne, History
Associate Professor Albert Robbat, Chemistry
Associate Professor Markus Wilczek, German
Assistant Professor Alexander Blanchette, Anthropology and Environmental Studies
Assistant Professor Kyle Emerick, Economics
Assistant Professor Andrew Kemp, Earth and Ocean Sciences and Environmental Studies
Assistant Professor Kelsey Jack, Economics
Assistant Professor Nimah Mazaheri, Political Science
Assistant Professor Alisha Rankin, History
Assistant Professor Benjamin Wolfe, Biology
Director and Senior Lecturer Julie Dobrow, Communications and Media Studies and Child Development
Senior Lecturer Cathy Stanton, Anthropology
Lecturer Ann Rappaport, Urban and Environmental Policy and Planning
Lecturer Ninian Stein, Environmental Studies
Environmental Studies is a multidisciplinary undergraduate program created to promote the study of our natural surroundings, designs that help minimize degradation of those surroundings, and the social and political tools needed to preserve and improve the environment. The program provides training in social sciences, natural sciences, engineering, and humanities. It offers both Majors and Minors.

For detailed information on the program please visit the Environmental Studies website: go.tufts.edu/ENVS.

UNDERGRADUATE MAJOR PROGRAM

Environmental Studies is offered as a dual major in conjunction with any stand-alone major in the School of Arts and Sciences and the School of Engineering. This dual-major program combines the depth of a disciplinary major, interdisciplinary training in environmentally studies, and the breadth of offering in any one of the tracks within environmental studies. Students who choose this major must find an advisor, declare the major, choose a track in consultation with their advisor, and plan a course of study.

The Environmental Studies major requires the completion of five core courses, five courses in a specialized track and an internship. The core curriculum requires students to master basic scientific principles of environmental processes, to examine interactions between technology and the environment, and to explore the societal context for implementing environmental policy. We recommend that students begin the major by taking Environmental Biology (Bio 7/Env 7) in the fall semester. The specific tracks include Track I: Environmental Science; Track II: Sustainability, Policy, and Equity; Track III: Environmental Communications; Track IV: Food Systems, Nutrition and the Environment; and Track V: Environmental Humanities. Eligible students can also self-design a track with help of their advisor. The track courses must include one introduction to the track course; a methods or research course and three elective courses, one of which must be a seminar and they must represent at least two departments. Student may double-count up to three courses for their co-major and up to two for a minor in another department or program. Students can count up to two classes taken abroad (approved by the ENVS Program) or more if they transfer as an equivalent class at Tufts University or are part of a Tufts abroad program. Students may only use one Experimental College class for the major/minor.

Track I: Environmental Science focuses on science and the tools necessary to detect, evaluate, and solve environmental problems (basic principles, theories, and methods in biology, chemistry, geology, and physics). Track II: Sustainability, Policy, and Equity focuses on human development policies and practices that can have both positive and negative effects on the natural ecosystem and human well-being, both now and in the future. Track III: Environmental Communication will require students to have knowledge of natural sciences, social sciences, and the arts and humanities to effectively communicate complex environmental issues to diverse audiences. Track IV: Food Systems, Nutrition and the Environment focuses on cultural, policy and scientific aspects of food production and consumption. Track V: Environmental Humanities focuses on cultural expressions and artistic representations of environmental issues, concentrating particularly on justice, ethics, activism, and social change.

UNDERGRADUATE MINOR PROGRAMS

The program offers two minors, one in Food Systems and Nutrition (for all students) and one in Environmental Science and Policy (only for Engineers).

Minor in Food Systems and Nutrition

The Food Systems and Nutrition minor encompasses a wide array of topics addressing sustainable food production, policy, access and nutrition. The aim is to provide a solid foundation to understand food systems from a holistic interdisciplinary point of view while providing students flexibility to specialize in an area that is most relevant to their interests and career goals. Whether a student's goal is to work for a non-profit organization or government agency, start his/her own business, or pursue a career in medicine, nutrition or food science, this minor provides critical interdisciplinary training to help each student be more effective in the future. The faculty advisor for the minor is Senior Lecturer Cathy Stanton.
The minor requires taking a total of six courses and is cohesively structured to maximize student learning. Students are advised to start with the required interdisciplinary gateway course (ENV 009 Food Systems). This course examines real-world issues facing stakeholders in the New England food system. Additionally, students must take an introductory course and three electives in the areas of Food Production, Food Access and Policy and Science and Nutrition. The minor ends with a required capstone course (ENV 190 Practicing in Food Systems) or equivalent pre-approved experience. The capstone class is a project-based course designed to integrate academic learning with application in a range of food systems settings and working with community partners.

**Minor in Environmental Science and Policy for Engineers**

The Environmental Science and Policy minor is only available to students in the School of Engineering. The minor is designed to give engineering majors greater exposure to natural and social sciences, and thereby deepen their understanding of the causes and solutions to problems related to environmental sustainability. The minor focuses on the integration of knowledge and approaches from different fields for the preservation and improvement of the environment. The goal of the minor is to empower student navigation across disciplines and to prepare engineering students for interdisciplinary collaboration in the area of environmental sustainability. The faculty advisor for this minor is Associate Professor John Durant.

The minor has three required core courses and three electives. Electives must be selected from key areas within the Environmental Studies curriculum, including one each of a select group of methods courses; an approved social science elective drawn from Anthropology, Economics, Political Science, or Urban and Environmental Policy and Planning; and an approved environmental studies seminar course. Only two of these courses may be double counted as foundation or concentration courses taken for School of Engineering majors.

**LUNCH & LEARN SEMINAR SERIES**

Every week during the academic year, Environmental Studies brings speakers from government, academia and non-profit organizations to give presentations on environmental topics. This is a great opportunity to broaden your knowledge, meet other faculty and students and network with the speakers. Students, faculty, staff, and visitors are welcome to attend. Food is generously sponsored by the Tufts Institute of the Environment. For more information visit http://as.tufts.edu/environmentalStudies/lunch/
Film and Media Studies

DIRECTOR:
Malcolm Turvey, Sol Gittleman Professor of Film and Media Studies, Art and Art History

CO-DIRECTOR:
Julie Dobrow, Senior Lecturer, Child Study and Human Development

CORE FACULTY:
Professor Nancy Bauer, Dean of Academic Affairs for Arts and Sciences; Philosophy
Professor Jay Cantor, English
Professor Lee Edelman, English
Professor Charles Inouye, German, Russian, and Asian Languages and Literatures
Professor Vida Johnson, German, Russian, and Asian Languages and Literatures
Professor Susan Napier, German, Russian, and Asian Languages and Literatures
Professor Christiane Zehl Romero, German, Russian, and Asian Languages and Literatures
Professor Laurence Senelick, Drama and Dance
Professor Stephen White, Philosophy
Professor Xuaping Zhong, German, Russian, and Asian Languages and Literatures
Associate Professor Amahl Bishara, Anthropology
Associate Professor Alessandra Campana, Music
Associate Professor Nina Gerassi-Navarro, Romance Languages
Associate Professor Monica White Ndounou, Drama and Dance
Associate Professor Kamran Rastegar, German, Russian, and Asian Languages and Literatures
Associate Professor Joel Rosenberg, German, Russian, and Asian Languages and Literatures
Associate Professor Modhumita Roy, English
Associate Professor Sarah Sobieraj, Sociology
Assistant Professor Ning Ma, German Russian Asian Languages and Literatures
Assistant Professor Jeremy Melius, Art and Art History
Assistant Professor Noe Montez, Drama and Dance
Assistant Professor Jacob Stewart-Halevy, Art and Art History
Senior Lecturer Elizabeth Lemons, Religion
Lecturer Khary Jones, Drama and Dance
Lecturer Claire Schub, Romance Languages
Professor of the Practice Jennifer Burton, Drama and Dance
Director Howard Woolf, Experimental College

Mass media saturate our lives, making media literacy an indispensable civic skill for the 21st century. Film and Media Studies (FMS) is an interdisciplinary program that educates students about the artistic potential and social effects of film and other forms of mass communication. Theoretical and practical knowledge are equally essential for media literacy, and all students take critical studies and production courses. The program combines film with media studies due to their increasing convergence, and is international in its outlook, thereby furthering Tufts'
commitment to globalism and diversity. The curriculum encompasses narrative, documentary, and avant-garde modes in live action and animated images as well as sound and text-based platforms. In keeping with Tufts’ rich liberal arts tradition, an interdisciplinary approach is fostered by core courses in film and media analysis, history, theory, and production and supplemented by electives in a variety of departments. By learning about the theory and practice of filmmaking and other forms of mass communication on a global scale, students become more discerning and active users of media, able to understand and employ them as powerful art forms that can change society for the better.

The program offers a major and a minor, both of which prepare students well for graduate studies/professional programs, and for career opportunities in film, television, advertising, public relations, journalism and digital media.

UNDERGRADUATE MAJOR IN FILM AND MEDIA STUDIES (FMS)

The Film and Media Studies major requires the completion of 12 courses:

- THREE required core courses
- SEVEN or EIGHT elective courses
- ONE- or TWO-course capstone

**Required Core Courses** (THREE courses)
The three required core courses impart analytical skills, historical background, and theoretical underpinnings, providing a coherent knowledge base and consistent language among FMS students. The three required core courses are:

- FMS20 Art of the Moving Image
- FMS21 Global History of Cinema
- FMS22 Media Literacy OR SOC40/FMS23 Media and Society

*We strongly encourage students to take the three required core courses early in their program of study.*

**Elective Courses**
Students must take either seven or eight elective courses (depending on whether they take a one- or two-course capstone) from the list of FMS-approved courses. Of these:

- One must be a theory course
- One must be an introductory film or media practice course
- One must be a non-U.S. film or media course
- One must be an upper level course or seminar

**Capstone Requirement** (one or two courses)
FMS majors are required to complete a one- or two-credit/semester capstone in the senior year. The capstone is the culminating experience of the FMS major, affording
students the opportunity to integrate, build upon and extend what they have learned in a direction of their choice. A two-credit/semester capstone qualifies a student to receive honors in FMS.

**One-Credit/Semester Capstone Options**
FMS majors may fulfill the capstone requirement through one of the following one credit/semester options:

- A Directed Study (FMS 195) in which a student undertakes an independent scholarly or creative project under the supervision of a faculty member
- An upper level course in which a student completes a scholarly paper of at least 15 pages (this is in addition to the FMS upper level elective requirement)
- Teach a course on a film or media topic through the Experimental College’s Perspectives program (EXP 0090)

FMS majors pursuing the one credit/semester capstone must also take an eighth elective.

**Two Credit/Semester Capstone Options**
FMS majors may fulfill the capstone requirement through a two-credit/semester Senior Honors Thesis or Senior Project, which allows students to do in-depth, self-directed work as scholars and/or artists.

All FMS majors are eligible to do a Senior Project. Only FMS majors who have been on the Dean’s List at least twice and have a GPA of at least 3.4 are eligible to do a Senior Honor Thesis.

Students wishing to pursue a Senior Honors Thesis or Senior Project must first submit a proposal in their junior year. If the proposal is approved, students take the FMS Senior Colloquium course in the fall of their senior year (FMS 29) and the Senior Honors Thesis/Senior Project (FMS 199) in the spring.

**UNDERGRADUATE MINOR IN FILM AND MEDIA STUDIES (FMS)**
The Film and Media Studies minor requires the completion of six courses:

- ONE required core course, FMS20 Art of the Moving Image
- ONE introductory level media/film practice course from the list of FMS-approved courses
- FOUR elective courses from the list of FMS-approved courses

A capstone project is not required for the FMS minor.

**FILM AND MEDIA STUDIES INTERNSHIP PROGRAM**
The internship program grants academic credit for internships in film, media and communications (FMS 99). Students can arrange to work at newspapers, magazines, film companies, advertising and public relations firms, television stations, radio stations, and publishing houses. Interns are required to work a minimum of 150 hours (approximately 12 to 15 hours each week), complete written requirements, and meet regularly with the faculty advisor. Consult the FMS website for eligibility and course requirements: http://as.tufts.edu/fms/internships
French

(FOR DEGREE REQUIREMENTS, SEE ROMANCE LANGUAGES.)
International Literary and Cultural Studies

Professor (Russian) Gregory Carleton, Department Chair; Russian Literature and Culture
Professor (Russian) Vida Johnson, Director of Russian Program; Twentieth century, film, women writers
Professor (Japanese) Hosea Hirata, Director of Japanese Program; Japanese literature
Professor (Japanese) Charles Inouye, Co-Director of International Literary and Visual Studies Program; Japanese literature
Professor (Japanese) Susan Napier, Japanese literature, popular culture, anime
Professor (German) Christiane Zehl Romero, Goldthwaite Professor of Rhetoric; Tübingen; Professor of German; Director of German Program; Twentieth century, women writers, film, advanced language
Professor (Chinese) Xueping Zhong, Director of Chinese Program; Modern Chinese literature, film
Associate Professor (German and Judaic Studies) Gloria J. Ascher, Co-director of Judaic Studies; German literature of the eighteenth and nineteenth centuries, Sephardic studies, Ladino language and literature, Scandinavian literature
Associate Professor (Arabic) Kamran Rastegar, Director of Arabic program; Modern Arabic literature, comparative literature, cinema studies, postcolonial studies
Associate Professor (Judaic Studies) Joel Rosenberg, Lee S. McCollester Associate Professor of Biblical Literature; Co-director of Judaic Studies; Central European writers, South African writers, film studies
Associate Professor (German) Markus Wilczek, Director of German Graduate Program; 18th Century to Modern, Environment
Assistant Professor (Arabic) Alexandra Chreiteh (Shraytekh), Mellon Bridge Assistant Professor of Arabic Studies
Assistant Professor (Chinese) Ning Ma, Pre-modern Chinese literature, comparative literature
Senior Lecturer (Japanese) Kiyomi Kagawa, Coordinator of Japanese language courses
Senior Lecturer (Chinese) Jinyu Li, Chinese language
Senior Lecturer (German) Saskia Stoessel, Coordinator of German language courses
Senior Lecturer (Chinese) Mingquan Wang, Coordinator of Chinese language courses
Lecturer (Arabic) Rana Abdul-Aziz, Coordinator of Arabic language courses
Lecturer (Russian) Marina Apteckman, Coordinator of Arabic language courses
Lecturer (Arabic) Rabab El Nady, Arabic language
Lecturer (Chinese) Jianping Feng, Chinese language
Lecturer (Hebrew) Hedda Harari-Spencer, Coordinator of Hebrew language courses
Lecturer (Arabic) Fadi Jajji, Arabic language
Lecturer (Japanese) Shiori Koizumi, Japanese language
Lecturer (Chinese) Joanna Kuriyama, Chinese language
Lecturer (German) Doris Pfaffinger, German language
Lecturer (German) Michael Powers, German language
Lecturer (Chinese) Min Wan, Chinese language
Lecturer (Chinese) Shaomei Wang, Chinese language
Lecturer (Japanese) Miki Yagi, Japanese language
Lecturer (Arabic) Souhad Zendah, Arabic literature

The Department of International Literary and Cultural Studies (formerly the Department of German, Russian and Asian Languages and Literatures) is the administrative home to the following foreign language and culture programs: Arabic, Chinese, German, Hebrew, Japanese and Russian. It is also the administrative home to two interdisciplinary programs, International Literary and Visual Studies (ILVS) and Judaic Studies. The department is also closely connected to other interdepartmental programs such as Film and Media Studies (FMS), International Relations (IR) and Middle Eastern Studies.

The Department offers nine majors and two graduate degrees. The undergraduate majors are Arabic, Chinese, German Language and Literature, German Studies, Japanese, Judaic Studies, ILVS, Russian Language and Literature, and Russian and East European Studies. The graduate degrees are M.A. in German and M.A. in German with Teaching Licensure. Students can minor in Arabic, Chinese, German, Hebrew, Japanese, Judaic Studies, and Russian. (For majors in IR and Middle Eastern Studies, as well as minors in FMS, please consult their websites.)

SPECIAL MINOR FOR ENGINEERING STUDENTS
Students earning a bachelor’s degree in engineering may minor in either Arabic, Chinese, German, Hebrew,
Japanese, or Russian language and culture. The minor requires a total of six (6) courses:

a. Four language courses above the beginning second-semester level: 3, 4, 21, 22.

b. One course in the social sciences concentrating on the area in which the target language is spoken (e.g., for Arabic: History 60, 61, 64, 65; for Chinese: History 40, 41, Political Science 126; for German: History 63, Political Science 125, 147; for Hebrew: History 71; for Japanese: History 42, 43, 133, 134, 135, Political Science 131; for Russian: History 61, 62).

c. A fourth-year level language course (Arabic 121, Chinese 121, German 121, Hebrew 121, Japanese 121, Russian 121) or, in conjunction with the social science course, a directed study in the language focusing on materials relevant to that course.

**Arabic**

Arabic is the fifth most widely spoken language in the world and is one of the six official languages of the United Nations. The Arabic Program, with its language, literature and culture courses, offers training in the study of the Arabic language at all levels, as well as offering studies in topics relating to Arab cultures and traditions. It offers a strong foundation in Modern Standard Arabic, as well as a wide range of courses taught in English on modern and classical Arabic literatures, cinema, gender and other cultural topics.

**UNDERGRADUATE CONCENTRATION REQUIREMENTS**

The Arabic major is designed to offer students a strong foundation in the Arabic language, as well as providing them with training to critically engage with Arabic literary and other cultural activities, such as cinema and other media. The major in Arabic requires ten courses in all: nine courses beyond Arabic 4, plus one approved course in a different department. Of the nine departmental courses, four must be Arabic language-based courses, while five must be selected from available departmental Arabic culture courses.

- **a. Language requirement:** Four Arabic language-based courses above Arabic 4: Arabic 21, Arabic 22, Arabic 121, Arabic 122, or further advanced Arabic language-based courses (subject to approval of the director of Arabic). Students who place higher than Arabic 21 upon entry into the program are expected to complete ten courses in all, in consultation with the Director of Arabic.

- **b. Culture requirement:** Five departmental Arabic literature or culture courses. Two of these five required courses may be filled by approved courses taken outside of the Medford campus.

- **c. Related course:** One course in a topic related to Arabic or the Middle East offered outside of Tufts’ Arabic Program. Courses in this category are subject to the approval of the Director of Arabic.

**UNDERGRADUATE MINOR PROGRAM**

The department offers a minor in Arabic requiring the completion of six courses beyond the intermediate level (ARB 3–4) and two courses in Arabic literature or culture. Minor checklist forms are available at [http://ase.tufts.edu/ilcs/requirements/arabic.htm](http://ase.tufts.edu/ilcs/requirements/arabic.htm).

**Chinese**

Chinese civilization is one of the longest and most continuous in the world. Home to one-fifth of the world population and undergoing rapid changes, China is playing an increasingly important role in today’s world. The Chinese program offers courses that aim at helping students achieve proficiency in modern Chinese language and acquire a comprehensive understanding of Chinese literature and culture in conjunction with their social and historical contexts.

**UNDERGRADUATE CONCENTRATION REQUIREMENTS**

The major in Chinese requires nine courses in the program beyond Chinese 4, plus one in a related field. Those who place out of language courses still need to complete ten approved courses. At least one course from category B must be a seminar offered by the Chinese program. If qualified, a student may opt to do an honors thesis.

- **a. Language requirement:** 4 courses beyond Chinese 4: 21, 22, 121, 122. Students placed above 21 or higher, upon completion of 122 or its equivalent, can take more advanced language courses (123, 124, 125, 126, 127, 128), or additional culture courses, or a combination of both.

- **b. Chinese 61 and four additional literature and cultural courses (taught in English) from Chinese Program offerings in the department. The four additional courses must include at least one seminar course. If ap-
proved, a student may opt to do an honors thesis, which can be counted as one seminar course. One culture course from Tufts-in-China will be counted in this category.

c. CHNS 52 or one China-related course offered by another program or department (PS 120, 126, 188-44; HIST 40, 41; FAH 13/CR13; REL 53). One culture course from Tufts-in-China will be counted in this category. Courses not listed above require approval by the Chinese program director.

d. One seminar, or honors thesis, double counted as one course in category B. Please see category B above for more information.

UNDERGRADUATE MINOR PROGRAM
The department offers a minor in Chinese requiring the completion of six courses beyond the intermediate level (Chinese 3–4). These must include two language courses at the 100 level and two literature/culture courses. Details are available from the departmental office. Minor checklist forms are available at http://ase.tufts.edu/ilcs/requirements/chinese.htm.

CHINESE LANGUAGE COURSES
Regular classes for the first four years (1 through 122) meet three times a week; regular classes at the higher levels (123 through 128) meet twice a week. Intensive classes meet six times a week.

THE CHINESE HOUSE
The Chinese House is a language-based housing unit sponsored by the Chinese program. The mission of the Chinese House is to provide language learning experience outside of the classroom and to promote and facilitate cross-cultural exchange and understanding within the larger community at Tufts. The Chinese House provides space and opportunity for the residents and non-residents to share their Chinese learning experience and practice their Chinese. Through academic, educational and social events, students in the Chinese House reach out to the rest of the University community, enriching the life and learning experience of the larger community at Tufts. Applications are available from the Chinese program early in the spring semester.

STUDY OPPORTUNITIES IN CHINA
Tufts-in-China
The Tufts-in-China program offers a fall semester in Hangzhou, China, at Zhejiang University, one of the top seven universities in China. The combination of the city of Hangzhou and the renowned Zhejiang University makes Tufts-in-China a unique program for students of Chinese language and culture. Well-prepared undergraduates who have successfully completed Chinese 4 (or the equivalent) by the time of departure are eligible to apply. Tufts-in-China is open to students from all majors.

German
The German program promotes an understanding of the extraordinary contributions made by German-speaking writers, artists, and thinkers to the past eight hundred years of civilization, and their implications for the contemporary world. A wide range of courses in German gives students with varied interests and goals the opportunity to attain a thorough knowledge of the language, literature, and general culture. The program also provides a significant number of courses in English so that students not conversant in German may become familiar with important aspects of German culture.

UNDERGRADUATE CONCENTRATION REQUIREMENTS
German Language and Literature
To major in this area, a student should take nine courses above the intermediate (German 3, 4) level. These should be courses taught in German and, depending on the student’s preparation, include German 21 and/or 22, 34, 44, 61, 62, and 100-level courses. A minimum of two 100-level courses taught entirely in German (121 and one literature/culture course at that level) is required. Also required is one course in a related field, such as German art, film, or history. The Tufts-in-Tübingen program (see below for description) is highly recommended for language and literature majors. Courses taken in German at the University of Tübingen in the areas of German language, literature, and culture (e.g., film) count toward the major in language and literature.

German Studies
As an alternative to the language/literature concentration, the department offers an interdisciplinary major with two options:
A. TUFTS-IN-TÜBINGEN PROGRAM
The Tufts-in-Tübingen program is a unique opportunity for students from various disciplines to spend their junior or senior year abroad experiencing the culture of German-speaking countries within the larger European context, and combining study outside of literature with their knowledge of German. All courses taken in German at the University of Tübingen in the areas of Politikwissenschaft, Volkswirtschaft, Geschichte, Kunstgeschichte, Volkskunde, Sozial- und Kulturwissenschaft, Germanistik, and Vergleichende Literaturwissenschaft will count toward the concentration requirement of nine German courses beyond the intermediate (German 3, 4) level and one course in a related field. On returning to the Tufts Medford/Somerville campus, two 100-level courses taught in German on the Tufts campus, 121, and one 100-level literature/culture course in German will be required.

B. TUFTS–MEDFORD/SOMERVILLE
This major requires nine courses plus one course in a related field approved by the German program. It includes at least five courses above the intermediate (German 3, 4) level taught in German, including German 121, and one 100-level literature/culture course taught in German. The remainder is a combination of courses dealing with German subject matter taught through at least three of the following departments: German, Russian, and Asian languages and literatures; history; music; philosophy; or political science. Courses taken in other departments must be approved by the German program for concentration credit.

UNDERGRADUATE MINOR PROGRAM
The department offers a minor in German requiring six courses above the intermediate level (German 3, 4). These must include two courses at the 100 level taught in German at Tufts/Medford; one of them is to be German 121. Minor Checklist Forms are available at http://ase.tufts.edu/ilcs/requirements/german.htm#minor.

GERMAN HOUSE
The department sponsors a German house, which provides a pleasant residential environment and the opportunity to enjoy intensive language practice in an informal setting. Every year a native German student from Tübingen is resident director and helps the students organize a variety of social and cultural activities. Preference is given to students who are currently enrolled in a German course.

TUFTS-IN-TÜBINGEN PROGRAM
Majors in German, as well as qualified juniors and seniors from other departments, are encouraged to spend a year abroad in the department’s overseas program, which normally consists of two semesters of study at Eberhard-Karls-Universität in Tübingen under the direction of the Tufts resident director. (One semester, in the spring only, is also possible.) A minimum of two years of college-level German is required to qualify for Tufts in Tübingen, but third-year-level proficiency is strongly advised. Students who have been accepted into the program may attain it by participating in a six-week intensive language course, which will prepare them for the transition into regular courses at a German university. This course starts at the beginning of September.

GRADUATE PROGRAMS
The department offers two Master of Arts degree programs in German. These programs typically enroll a small number of highly motivated and talented students, who—together with faculty both on the Tufts campus and in Tübingen—form a supportive, stimulating, and congenial community that helps students realize their full potential. Both master’s programs provide a wide range of courses in language, literature, and culture, and also the use of media, including hypermedia presentations in language and culture courses.

Tufts-in-Tübingen
All students may choose to study one year at the Eberhard-Karls-Universität in Tübingen, Germany, and one year on the Tufts campus; or they may spend both years on the Tufts campus in Medford/Somerville. The Tufts resident director in Tübingen offers an informal colloquium to acquaint students with traditional and contemporary aspects of German cultural life, and assists students in planning a program of study that draws upon university lecture courses and seminars. On the Tufts campus students do regular course work, participate in a graduate colloquium, and serve as teaching and research assistants.

Master of Arts in German
The program requires two academic years and is designed to prepare students for doctoral work in German
Master of Arts in German with Teaching Licensure
The program requires two academic years plus one summer, and is offered in conjunction with the Department of Education. It is designed to prepare highly qualified secondary school teachers.

Master of Arts in Teaching (M.A.T.)
The Department of Education, in conjunction with the German program, offers the M.A.T. degree in German as a foreign language. For more information and application materials, please contact the Department of Education.

Japanese
The Japanese program offers five levels of Japanese language instruction and introduces students to many facets of Japanese culture—especially literature, film, and visual culture. The major prepares students for careers in academics, business, law, diplomacy, or technology where an in-depth knowledge of Japanese language and culture is an invaluable asset.

UNDERGRADUATE CONCENTRATION REQUIREMENTS
The major in Japanese requires nine courses beyond Japanese 4, plus one in a related field. Those who place out of language courses still need to complete ten approved courses.

a. Language requirement: four courses beyond Japanese 4; continuation to Japanese 123, 124 strongly recommended.

b. Japanese 061 and four additional literature/culture courses from the Japanese offerings in the department. Two of these courses must be at the 100 level, including one seminar. If qualified, a student may opt to do an honors thesis (JPN 198, 199) instead of a seminar. Only one course with a half Japanese content can count toward this category.

c. One course in Japanese culture offered by another department and approved by the program director.

UNDERGRADUATE MINOR PROGRAM
The department offers a minor in Japanese requiring the completion of six courses beyond the intermediate level (JPN 003–004). These must include two language courses (121, 122, or 123, 124) and two literature/culture courses. Details are available from the departmental office.

JAPANESE CULTURE HOUSE
The department administers the Japanese Culture House, a coeducational undergraduate dormitory that serves as an informal center for Japanese studies on campus. It aims to provide an experiential learning environment for students who would like to improve their language skills and deepen their knowledge of Japanese culture. It also accommodates native speakers who would like to share their knowledge of Japan with other students and take a leading role in organizing social events related to Japan. The minimum requirement to be a resident is Japanese 002 or equivalent. The selection committee considers the leadership potential of the applicants as well as the balance of gender and of linguistic levels. Together the occupants organize various cultural activities that further the understanding of Japan on campus, as well as weekly Japanese chat hours to which any student interested in practicing conversation is welcome.

STUDY OPPORTUNITIES IN JAPAN
Tufts-in-Japan
The Tufts-in-Japan program is offered at Kanazawa University, a prestigious national institution in a picturesque city rich in history. Students are strongly recommended to study in Japan during their junior year. Excellent scholarships are available. Tufts financial aid can also be used.

Judaic Studies
CO-DIRECTORS:
Associate Professor Gloria J. Ascher, German and Judaic Studies
Associate Professor Joel Rosenberg, Lee S. McCollester Associate Professor of Biblical Literature; Judaic Studies
The program in Judaic Studies encompasses study of some 4,000 years of ancient Israelite and ancient, medieval, and modern Jewish civilization, with attention to the influence of Israelite and Jewish culture on the many cultural and religious traditions that grew from it. The major in Judaic Studies comprises the courses listed below under Hebrew and Judaic Studies and a number of primary or related courses in other departments.

UNDERGRADUATE CONCENTRATION REQUIREMENTS
The major in Judaic Studies consists of ten courses—eight primary courses and two related courses. Courses in Hebrew language at the level of Hebrew 21, 22, and 121, 122 may be counted as primary courses. Courses not listed below, offered at Tufts and elsewhere, are acceptable upon approval of the program directors (Professor Gloria Ascher, Olin 332, and Professor Joel Rosenberg, Olin 322), but at least four of the primary courses must be taken at Tufts. Students majoring in Judaic Studies must have the equivalent of three years of Hebrew, or two years of Hebrew and two years of a second language related to the student’s special interests within the field. Qualified students majoring in Judaic Studies are encouraged to consider participating in the Thesis Honors Program.

Primary Courses
Drama 172 Imagining the Holocaust on Stage and Screen
Drama 272 Confronting Genocide on Stage and Screen
English 159 Contemporary Jewish Fiction
English 162 Philip Roth and Company
English 164 Representing the Jew
Judaic Studies 48 Israeli Film
Judaic Studies 55 Technology and Jewish Oral Tradition
Judaic Studies 65 Introduction to Yiddish Culture
Judaic Studies 73 Aspects of the Sephardic Tradition
Judaic Studies 78 Jewish Women
Judaic Studies 84 The Sources of Jewish Tradition
Judaic Studies 91-01 Ladino Language and Culture
Judaic Studies 92-01 Introduction to Judaism
Judaic Studies 92 Special Topics
Judaic Studies 93 Directed Study
Judaic Studies 95 Topics in Jewish Literature
Judaic Studies 99 Judaic Studies Internship
Judaic Studies 126 Roots of the Jewish Imagination
Judaic Studies 132 The Book of Genesis and Its Interpreters
Judaic Studies 136 The Story of King David
Judaic Studies 142 Jewish Experience on Film
Judaic Studies 150 Music and Prayer in the Jewish Tradition
Judaic Studies 159 Contemporary Jewish Fiction (cross-listed as English 159)
Judaic Studies 162 Philip Roth and Company (cross-listed as English 162)
Judaic Studies 164 Representing the Jew (cross-listed as English 164)
Judaic Studies 191 Special Topics
Judaic Studies 193, 194 Advanced Directed Study
Judaic Studies 198, 199 Senior Honors Thesis
Religion 21 Introduction to the Hebrew Bible

Related Courses
Related courses establish links between Judaic Studies and other disciplines by examining such topics as countries or regions that are major sites of Jewish civilization, past or present; the life of cosmopolitan and multiethnic societies more generally; the dynamics of tradition; the impact of modernity and historical crisis on traditional societies; issues of philosophy, ethics, myth, religion, and spirituality that bear upon Jewish life and thought; issues of race, class, gender, and sexuality in the life of a culture; and the legacy of biblical and Jewish tradition in world cultures. A student may, with the approval of the program directors, substitute an appropriate course not on this list.

American Studies 16 American Identities
Anthropology 119 Peoples of the Middle East
Anthropology 132 Myth, Ritual, and Symbol
Arabic 62 Modern Arabic Literature
Arabic 64 The Literary Qur’an
Art History 22 Iconoclasm and Iconophobia: The Threat of the Image (cross-listed as Religion 24)
Art History 28/128 Medieval Art in the Mediterranean: Pagans, Jews, Christians, Muslims (cross-listed as Religion 28/128)
Classics 26 Ancient Egypt
Classics 75 Classical Mythology
Classics 148 Time and Festivals in the Ancient World
Classics 151 Ancient Philosophy
English 49 The English Bible
English 69 Contemporary Multi-Ethnic Literature
English 77 The Modern Mind
English 175 Post-Structural Literary Theory
English 177 Feminism, Literature, Theory
English 180 Psychoanalysis and Cultural Criticism
English 181 The Politics of Reading
History 70 Middle East to World War I
History 71 Middle East and North Africa since World War I
History 167 Medieval Islam
International Literary and Visual Studies 114 Politics and Literature in Russian and Eastern Europe (cross-listed as Russian 114)
Peace and Justice Studies 120 Sociology of War and Peace (cross-listed as Sociology 120)
Philosophy 16 Philosophy of Religion
Philosophy 48 Feminist Philosophy
Philosophy 55 The Making of the Modern Mind
Philosophy 126 Theories of Human Nature
Philosophy 128 Human Rights, History and Theory
Political Science 41, 42 Western Political Thought
Political Science 134 Comparative Politics of the Middle East
Religion 6 Philosophy of Religion
Religion 48 Introduction to Islam
Religion 195 Mystics
Russian 73 The Bible in Russian Literature
Sociology 110 Racial and Ethnic Minorities
Sociology 143 Sociology of Religion
Spanish 130 Civilization of Muslim Spain
World Civilizations 5 Time and Festivals
World Civilizations 6 Time and Modernity
World Civilizations 9 Memory and Identity in World Cultures I
World Civilizations 10 Memory and Identity in World Cultures II
World Civilizations 85 Film and Nation: Russia and Central Asia
World Literature 120 Central European Writers
World Literature 122 South African Writers

UNDERGRADUATE MINOR PROGRAM
The minor in Judaic Studies consists of six courses selected from those approved for the major, including at least four primary courses. Four of the six courses must be taken at Tufts and must include a course in which
a substantial integrative project is produced. Two years of Hebrew or the equivalent are strongly recom-
manded. For further information consult the program directors. Minor checklist forms are available at
http://ase.tufts.edu/grall/requirements/judaicMinor.htm#hebrew.

MINOR IN HEBREW
The minor in Hebrew consists of Hebrew 21, 22, 121, and 122 (third- and fourth-year Hebrew language,
with an introduction to modern Hebrew literature), or equivalent, and two additional courses in He-
brew-based Judaic Studies, from the following list:

  English 49 The English Bible
  Judaic Studies 48 Israeli Film
  Judaic Studies 73 Aspects of the Sephardic Tradition
  Judaic Studies 84 The Sources of Jewish Tradition
  Judaic Studies 126 Roots of the Jewish Imagination
  Judaic Studies 132 The Book of Genesis and Its Interpreters
  Judaic Studies 136 King David and the Israelite Monarchy
  Judaic Studies 150 Music and Prayer in the Jewish Tradition
  Religion 21 Introduction to the Hebrew Bible

Students who place out of third or fourth-year Hebrew by language placement exam must still take a total of
six courses, chosen from the above list.

Russian
The Russian Program offers two majors: one in Russian Language and Literature, and the other in Russian
and East European Studies that incorporates courses taught in the departments of History and Political Sci-
ence. We offer five years of Russian language courses and an array of courses in English, as well as some in
Russian, that provide a survey and an in-depth study of Russian literature, culture, and film, not only for our
majors but for all students who want to broaden their knowledge and understanding of the humanities, world
languages, and cultures. For both majors a semester of study in Russia is strongly recommended (see be-
low).

UNDERGRADUATE CONCENTRATION REQUIREMENTS
Russian Language and Literature
The Russian Language and Literature major places emphasis on a sound knowledge of the Russian lan-
guage, literature, and culture. Because literature has played a central role in Russia’s intellectual and politi-
cal life, its study provides the student with insight into Russian society, history, and culture. At the same
time, the moral, philosophical, and artistic issues raised by world-renowned writers, such as Dostoevsky,
Tolstoy, and Chekhov, are universal in scope and help shape our understanding of the human condition.
Russian writers have also had a major impact on the development of the novel, the short story, and drama
worldwide. The major provides a firm preparation for graduate study in a variety of fields or potential em-
ployment in Russian-related areas, such as government, international business and law, journalism, teaching,
translation, and consulting. Special attention is paid to developing advanced competence in Russian lan-
guage, to modern and historical approaches to literature and culture, and to how literature and culture shape
and influence history and politics.

The major requires ten courses as follows:

a. Russian 21 and 22.

b. Three advanced (100-level) courses conducted in Russian. At least one of these must be in Russian liter-
   ature (Russian 131, 132, or another 100-level course in literature). At least one must be a language course
   (e.g., 121 or 122). An advanced course in some special topic (e.g., Russian 123, 125, 191, 192) may be
   substituted for Russian 121 or 122 with program approval. Students coming back from a semester in
   Russia are required to take one 100-level course conducted in Russian. (Students going abroad in the
   spring of senior year must take one 100-level course in Russian before leaving.)

c. Four courses in Russian literature (must include Russian 60 and either 61 or 62).

d. One additional course in Russian culture (literature, art, music, film, history, political science, or reli-
gen).
Students who place out of Russian 21, 22, 121 and/or 122 on the basis of the Russian language placement examination administered by the department still need to take ten courses to complete the major.

**Russian and East European Studies**

The Russian and East European Studies (REES) major offers the student training and regional expertise in a variety of disciplines that shape Russia and Eastern Europe such as history, literature, politics, and culture, as well as a solid grounding in oral and written Russian. Broadly speaking, for the purposes of this major “Russia” entails the geographic area of the former Soviet Union including Central Asia. The major is designed for students interested in Russia and related areas who might pursue a career in this field, particularly with an orientation to graduate work in Russia/Eastern Europe, but also for students planning to enter law, business, international relations or diplomacy in which this degree would be an useful asset.

The major requires ten courses as follows:

**a.** Four core language courses: Russian 21, 22, 121, 122, or the equivalent. For Russian 121 and 122 the student may substitute Russian 123, 125, or any advanced course related to the area in which all readings are in Russian. Students coming back from a semester in Russia will be required to take one 100-level course conducted in Russian. (Students going abroad in spring of senior year must take a 100-level course in Russian before leaving.)

**b.** Six courses with a primary focus in the Russian and East European area chosen from the following two categories: (1) literature and culture; (2) history, politics and society. At least two courses must be taken at Tufts in each of the designated categories. One of the six courses must be an advanced special topics course, a seminar, an advanced directed study, or similarly oriented course approved by the program.

Students who place out of Russian 21, 22, 121 and/or 122 on the basis of the Russian language placement examination administered by the department still need to take ten courses to complete the major.

**UNDERGRADUATE MINOR PROGRAM**

The department offers a minor in Russian requiring the completion of six courses above the intermediate level (Russian 3, 4). These must include two courses at the 100 level taught in Russian and may include up to two culture courses in English. Minor checklist forms are available at [http://ase.tufts.edu/grall/requirements/russian.htm#minor](http://ase.tufts.edu/grall/requirements/russian.htm#minor).

**RUSSIAN/SLAVIC CULTURE HOUSE**

The department administers the Russian/Slavic Culture House, a coeducational undergraduate dormitory that serves as an informal center for Russian and East European studies on the campus. The house sponsors dinners, films, receptions, and lectures. Residence in the house is open to all students who satisfy any of the following requirements: (1) enrollment in courses related to the Russian and East European culture area (languages, history, literature, art, political science, or economics); (2) Slavic or East European background; or (3) a strong interest in the area. Applications for residence in the house are available from the department early in the spring semester.

**STUDY OPPORTUNITIES IN RUSSIA**

Majors are encouraged to study in Russia for a summer, semester, or full year. Recommended programs include CIEE, ACTR, and Middlebury College. All students studying abroad are required to take a placement exam upon their return. For more information, see the Russian program faculty.

For more detailed information, please visit the website [http://ase.tufts.edu/ilcs/studyAbroad/#russian](http://ase.tufts.edu/ilcs/studyAbroad/#russian).
Greek

(FOR DEGREE REQUIREMENTS, SEE CLASSICS.)
The study of history reveals the past, enlightens the present, and influences the future. Historians seek to understand how nations, societies, and individuals have lived and thought, and why they have behaved the way they did. Supplying the context that informs art, ideas, institutions, and events, history illuminates all of human experience.

Trained to examine evidence carefully and evaluate received interpretations of the past, students construct their own understanding of historical processes and occurrences, building arguments from primary sources, historians’ writings and appropriate theoretical literatures. In history you also write gripping narratives, empathize with the experiences of people who have gone before and re-imagine past worlds.

The Tufts History faculty promotes a diversity of approaches and ways of understanding the past. From the history of medicine, to labor and migrant histories, to transnational and material culture, courses challenge students to analyze historical material. The department offers a wide range of courses designed to meet the needs and interests of students with differing concerns and levels of preparation. General surveys (numbered below 100) cover entire periods, fields, or geographic areas, while thematic courses (numbered 100 to 189) provide more specific, comparative, or regional perspectives. Foundation Seminars (announced each semester and numbered History 90–97) introduce undergraduate majors to the historian’s craft; Research Seminars (numbered 190 to 197) provide them with the opportunity to practice it through a significant research project. Students interested in specialized work are encouraged to explore independent study or to consider the option of writing a Senior Honors Thesis.
Undergraduates may adopt history as either a major or a minor concentration. The History Graduate Program offers the M.A. degree, with the option of earning a certificate in Museum Studies, and (in a limited number of fields) the Ph.D.

**UNDERGRADUATE CONCENTRATION REQUIREMENTS**

The History major requires completion of a minimum of 10 courses, ordinarily to be taken within the department. History courses taken at Tufts’ programs abroad or transferred from other accredited institutions may be counted toward the minimum of ten courses. Courses taken outside of Tufts, however, do not count as graded courses. No more than four of the history major concentration requirements may be transferred from other institutions.

In consultation with their advisor (normally prior to taking such courses), majors may count up to two courses from outside the department in cases where it may be difficult or impossible to complete their concentration core (see below) within the department. Such courses may not count toward either of the seminar requirements. A minimum grade of C- is required in all courses counted toward the completion of the major. Of the ten courses, the following are required: (1) one Foundation Seminar (a high-demand course) to be completed during the sophomore year or as soon as possible after declaration of the major; (2) one course covering the pre- and early-modern period; (3) one course in U.S. history, one in European history, and one in any two of the following areas: global/transregional, Africa, Latin America, the Middle East or Central Asia, East Asia, and South Asia; (4) four or more courses to serve as a concentration core (this may be defined geographically or topically); and (5) one Research Seminar (a high-demand course) to be taken within the History Department at Tufts.

In consultation with their advisor, majors should prepare for their research seminar by taking courses, either at Tufts or abroad, that build toward this capstone experience. Ordinarily a Research Seminar will form part of the concentration core. Those intending to write a Senior Honors Thesis (see below) should plan to take their research seminar in the second semester of their junior year or, at the latest, the first semester of their senior year. In exceptional cases, thesis writers may petition to be exempt from the Research Seminar requirement.

**UNDERGRADUATE MINOR PROGRAM**

The department offers a minor in history requiring a minimum of five courses in history to which the following conditions apply: (1) one history course covering the pre- or early-modern period; (2) one history course in at least two of three areas: North America, Europe, other world areas (e.g., Africa, Latin America, Middle East/Central Asia, East Asia, or South Asia); (3) three courses developed as a coherent core in consultation with the student’s History advisor.

Both majors and minors: Please note that a single course may fulfill several of the concentration requirements.

**DEPARTMENTAL HONORS**

When nominating seniors for honors, especially magna and summa, the department looks carefully at qualitative issues—performance in Foundation and Research Seminars, evidence of sophistication in work beyond the introductory level (e.g., work in advanced courses, Senior Thesis and independent study)—and not simply the quantitative criteria of GPA and A’s earned.

**The Senior Honors Thesis in History**

The Senior Honors Thesis program in History is intended for those students who have a record of high performance in upper-level history courses and who have developed an interest and some background in a well-focused research topic. Students interested in writing a Senior Honors Thesis should consult their advisors, the guidelines described under Thesis Honors Program in this bulletin and the History Department Web pages. For an Honors Thesis in History the thesis committee must have three members: two from History and one from an outside department. All thesis writers must enroll in the thesis seminar, HIST 198, for the fall semester of their thesis year.

**GRADUATE PROGRAM**

The Tufts History Department encourages students to study subjects and problems that transcend traditional academic constraints and consider national and regional histories in the broadest possible contexts. Our collaborative approach places an emphasis on global or interregional connections and comparisons, as well as on the use of interdisciplinary methods.

The Tufts History Graduate Program cultivates academic excellence and prepares students for leading
roles in education and research, as well as in the fields of business, administration and world affairs.

The Tufts Graduate Program offers the M.A. degree in History or in History and Museum Studies. It also offers individual courses to students earning a certificate in Museum Studies. The Ph.D. is offered in Modern South Asia and Global History.

Members of the History Department offer preparation at the M.A. level in regional fields that include South Asia, East Asia, Africa, Latin America, Europe and the United States. In addition to the regional fields, the department supports thematic fields, which combine interdisciplinary and comparative approaches. Students who choose not to specialize in a regional field may select a thematic field of study such as the following:

- Civil Society, the Public Sphere, and the State
- Film, Media, and History
- Gender and Sexuality
- International and Intercultural Relations
- Colonialism and Postcolonialism
- Labor and Social Movements
- Nationalism and Collective Identity

**Master of Arts in History**

The Master’s Program is a small, selective program of graduate study that emphasizes comparative understanding of historical processes. It is organized around colloquia in comparative and regional topics, the preparation of specified fields, and individual research in consultation with a faculty member.

The program is designed both to prepare students for doctoral programs in history and to enhance the historical knowledge and interpretative skills of professionals working in secondary schools, libraries, foundations, and museums. GRE scores (verbal, quantitative, analytical) and, if appropriate, TOEFL are required for admission to the graduate history program. Since the curriculum depends greatly upon individualized interaction between faculty and students, admission is contingent, in part, on an appropriate match between faculty and student interest.

Completion of the program requires proven reading proficiency in at least one foreign language or mastery of a research methodology in another discipline. Anyone who plans to meet the requirement in a foreign language or disciplinary research methodology must indicate a plan to acquire this knowledge within two years.

Normally, students are expected to complete the program within two academic years. The successful completion of ten courses is required. These courses must include the following: the Historiography Proseminar (History 200), one Graduate Colloquium, at least one Research Seminar, and either an additional Research Seminar or directed graduate research.

Up to two of the ten courses required for the master’s degree may, by prior agreement with the principal advisor, be taken in a department other than History. Students may take selected undergraduate courses, numbered 1 through 99, for graduate credit by enrollment in the related 200-level readings course by arrangement with the principal advisor and the relevant instructor. Graduate students may not take undergraduate colloquia. Appropriate courses offered by the Fletcher School will be accepted by petition for graduate credit in History.

A student may devote two out of ten courses to the writing of a thesis. In that case, only one additional course needs to be allocated for a Research Seminar or directed graduate research. In the second year of graduate study, the student will present a research project drawn from graduate course work at Tufts to an ongoing Graduate History Roundtable for critical discussion. Students will choose two fields of study to be prepared for examination. These fields may be regional or comparative in focus. Each student will consult with his or her principal advisor and a field committee to design a sequence of courses that will provide preparation for examinations in each field. Examinations must be taken at least six weeks prior to graduation. If the student chooses to write a thesis, only one field, different from the field of the thesis, need be prepared for examination.

**Master of Arts in Museum Studies and History**

The Tufts Museum Studies Program provides qualified post-baccalaureate students with professional training in the administration, preservation, and interpretation skills required for a career in the museum field. The Certificate in Museum Studies requires four graduate-level courses and an on-site internship. History M.A. candidates may take individual Museum Studies courses that fit into their program. Students interested in the museum studies courses or the certificate program should contact the Office of Graduate
Criteria for admission to the Master’s Program in History and Museum Studies are the same as those for
the Master’s Degree in History alone. The requirements for completion of a master’s degree in History and
Museum Studies are (1) the successful completion of eleven courses, including the Historiography Proseminar (History 200), one research course, the Museum Studies Foundation course, three Museum Studies
elective courses, and the Museum Studies internship; (2) preparation of one regional or comparative field of
study and examination in that field (see requirements in preceding description of master’s degree in History);
a thesis is optional; (3) proven reading proficiency in at least one foreign language or mastery of a research
methodology in another discipline; (4) the presentation of one research project drawn from course work to
the Graduate History Roundtable.

Doctor of Philosophy

The Tufts History Department offers the Ph.D. in History in two fields: Modern South Asia and Global
History. The Ph.D. program in history accepts only well-prepared students who intend to work closely with
a particular Tufts faculty member in a limited number of fields. Students in the Tufts M.A. program may
apply to be transferred into the Ph.D. program after one year of study, and the department will consider ap-
lications from students who have completed a master’s degree in history or the equivalent elsewhere.

Requirements for admission are as follows: exceptional performance in M.A. course work; proficiency
on entrance in at least one foreign language (proficiency in two foreign languages is required before comple-
tion of the degree); GRE (Aptitude section only) and, if appropriate, TOEFL; detailed statement of intent,
including discussion of planned dissertation field; and the written support of a primary Tufts faculty sponsor,
who will have arranged for at least one other faculty advisor. Students admitted with a master’s degree from
another university will be allowed to transfer up to eight course credits.

Requirements for completion are as follows: proficiency in two foreign languages; completion of sixteen
courses at the graduate level, including the historiography proseminar and two graduate colloquia; at least
three semesters of independent readings or research; oral and written examinations in three fields, based on
course work and readings, administered by the appropriate members of the department; and a dissertation
directed by the supervising faculty, to be read and defended before a committee including the advisor, at
least one other member of the department, and a third faculty member in the field, drawn, if possible, from
another institution. This defense will also include presenting a chapter to the Graduate-Faculty Roundtable.
See additional requirements for the South Asia Ph.D. below.

Modern South Asia

The Tufts History Department has a distinguished tradition of offering doctoral training in Modern South
Asian history. Successful Ph.D. candidates have gone on to obtain positions in some of the most prestigious
institutions of American academe. The program provides doctoral students with an ambience geared to in-
tense and focused research into the most pressing questions of South Asian scholarship today, while also
connecting students to the larger international expertise of the Tufts History Faculty, as well as the resources
of the Tufts Fletcher School of Law and Diplomacy. Students in this major field also partake of the active
intellectual life surrounding South Asian studies in the Boston area, including the Center for South Asian
and Indian Ocean Studies at Tufts University (http://ase.tufts.edu/southasian).

The Modern South Asia Ph.D. immerses students in both the breadth and the detail of a complex arena of
historical inquiry. Students study local and regional specificities, and also the large-scale political, economic,
social, cultural and intellectual interactions that have made South Asia a nexus for globalizing forces in the
modern period.

Focus is placed on building expert skills in historical reasoning and analysis, in good writing and exposition,
and in historiographic theory and debates.

Students who enter the Ph.D. program in Modern South Asian history at Tufts secure themselves a place
in a scholarly tradition that has significantly influenced academic discussions in the United States and abroad
by the formulation of new themes and heuristic categories, and by the impressive caliber of its work.

Additional requirements for the Ph.D. in Modern South Asian History are as follows:

a. Language requirements: English, at least one major South Asian language, and one other appropriate
language.

b. Primary field of concentration: Nineteenth- and twentieth-century South Asia.

c. Secondary geographic field: An appropriate field in the history of the Middle East, East Africa, Central
Asia, Southeast Asia, or East Asia.

d. Thematic field: An appropriate interdisciplinary and comparative field in topics such as nationalism,
agrarian or labor history, or world history.
For more detailed information, please visit the website http://ase.tufts.edu/history.
With hardware processing power increasing and software development techniques improving, the user interface is fast becoming the key bottleneck in developing computer products that meet market needs. When interface design does not reflect the needs of the intended user, products fail in the marketplace and enormous sums of money are spent on documentation, help lines, and training courses to overcome the difficulties of running programs. Much of this difficulty can be avoided with proper attention to both the physical and the psychological constraints of the user.

In an interdisciplinary collaboration between the Department of Mechanical Engineering, the Department of Psychology, the Department of Electrical and Computer Engineering, the Department of Computer Science, and the Department of Occupational Therapy at Tufts, this four-course, graduate-level certificate is designed to train the next generation of computer professionals for tomorrow’s complex challenges. The program is open to individuals with a bachelor’s degree, and is designed to be pursued on a part-time basis by computer programmers, Web designers, human factors professionals, software engineers, and user interface designers who wish to develop or enhance their user-interface design and implementation skills.

For more information, contact the program administrator, Angela Foss, at 617-627-2320 or visit the website http://engineering.tufts.edu/me/graduate/certHCI.htm.
Human Factors Engineering

(SEE ENGINEERING PSYCHOLOGY/HUMAN FACTORS ENGINEERING.)
The Interdisciplinary Doctoral Program has been established to accommodate those interested in pursuing doctoral level studies in areas that cannot be accommodated in one of the departmental doctoral programs within Arts and Sciences or Engineering. The Graduate School of Arts and Sciences (GSAS) encourages applicants to be familiar with Tufts’ graduate level offerings and with its faculty. A standing committee of GSAS, the Interdisciplinary Doctorate Overseers Committee (IDOC) serves as the admissions committee and will monitor the progress of all students matriculated into the program.

Admission to the Interdisciplinary Doctoral Program will be highly selective. The applicant must demonstrate the ability to do independent research/scholarship. Normally this will be demonstrated by having completed a master’s degree with a dissertation requirement at an accredited graduate school, or in some cases by published research. Creative works such as art, musical composition, performance, and performance direction, though laudable, are not acceptable as the sole qualifications for admission into a scholarly doctoral program of study.

Admission to the Interdisciplinary Doctoral Program will be for only those qualified applicants with demonstrated proficiency in independent study at the graduate level and whose research area is interdisciplinary and carefully matched to Tufts human, academic and physical resources.

Admissions Requirements: Application to the Interdisciplinary Doctoral Program is a two-step process.

Step One:
A regular Graduate School of Arts and Sciences application form should be submitted with all documents including GRE scores, together with the application fee, transcripts, letters of recommendation, etc.

In addition all Interdisciplinary Doctoral Program applicants must submit a description of research interests including the proposed area of dissertation work. This should include an explanation of how the project is interdisciplinary beyond what would be possible in a single department. The applicant should list faculty members that might be approached to be the principal advisor for the applicant or on the applicant’s advisory committee. Applicants are encouraged to initiate informal conversations with potential principal advisors or members of an advisory committee. The description of research interests together with a list of possible advisors should not be more than one page in length.

After completion of Step One the Interdisciplinary Doctoral Committee (IDOC) will review the application to determine how it meets the requirements for the Graduate School of Arts and Sciences and notify the applicant if it is appropriate to proceed to Step two. This regular Arts and Sciences part of the application will be available for faculty members who would be potential members of the applicant’s advisory committee.

Recommendation to proceed to Step Two is NOT acceptance into the program or the Graduate School of Arts and Sciences.

Step Two:
When recommended for the second step the applicant should contact faculty members that may be appropriate to serve as the principal advisor or members of the advisory committee and then write a more extensive description of the project.

Description of the project, limited to five single spaced pages
The description of the proposed project must show how the project will make an original contribution to the field of study. It should also indicate how the research involves methods, techniques or theoretical approaches that are characteristic of two or more disciplines. To qualify for the Interdisciplinary Doctoral Program, a study design must realize added value by the very fact of combining two or more disciplinary approaches. The candidate must provide a strong case that the project would not be appropriate for a single doctoral-granting department at Tufts and that the project would not fit easily within a traditional doctoral program at another institution. It is not sufficient that the subject matter of investigation is discussed in the literature of more than one discipline.

Confirmation of an advisory committee
The applicant must assemble an advisory committee consisting normally of at least three faculty members from Arts, Sciences and Engineering. When an applicant approaches faculty members to serve on his or her advisory committee the applicant should tell each faculty member that they can review the first step application to GSAS. Additional members of the advisory committee may be selected from other schools at Tufts and, when appropriate, other universities. As a component of the admissions process, IDOC must approve the suitability of the advisory committee. One person must agree to serve as the principal advisor and chair of the advisory committee, providing major direction for the student’s progress through coursework, examinations and the dissertation. That person must be a full time tenured or tenure track faculty member of Arts, Sciences, and Engineering, situated in Medford and actively engaged in the field of the proposed research. All members of the advisory committee must submit a brief statement declaring their commitment to the project, and elaborating their specific role and responsibilities. The advisory committee should meet to review and approve the candidate’s Interdisciplinary Doctoral proposal prior to its submission to IDOC.

IDOC must certify that the criteria for admission entailed by the proposal meet Tufts doctoral standards and the requirements of the Interdisciplinary Doctoral Program. If the principal advisor is a member of a doctoral granting department, the graduate admissions committee of that department may be consulted in order to clarify whether the proposed program of study is suitable for the doctoral program of that department. In the case where the principal advisor is not a member of a doctoral-granting department, it is expected that at least one member of the advisory committee will have mentored doctoral students.

**Plan of study**

The applicant must compile a list of graduate level courses to be taken for the degree and lay out the schedule in which they will be taken. When the proposal is presented to IDOC in its capacity as admissions committee, the candidate, the principal advisor and at least one other member of the advisory committee must be in attendance. A majority vote of IDOC in favor of the proposal will constitute a recommendation for admissions to the Dean of GSAS.

- The requirements for completion of the program should conform to the general requirements of the doctoral degree as stated in the A&S and Engineering Bulletin.
- The candidate must have at least two semesters of full-time residence on the Medford campus. Some tuition scholarship aid will be available from the graduate school, to be negotiated on an individual basis.
- The candidate must meet with his or her advisory committee at least twice a year, and a progress report must be filed with IDOC twice a year. Progress reports are due by the end of the first week of classes of the spring semester and two weeks before the beginning of classes in the fall semester. It is the responsibility of the candidate and the principal advisor to file the progress report, and failure to do so may result in a recommendation by IDOC for dismissal from the program. Any change in the committee makeup or program of study must receive prior approval by IDOC.
- The guidelines for qualifying procedures or examinations should follow the principal advisor’s department’s guidelines wherever possible; otherwise the candidate’s advisory committee, including the principal advisor and the IDOC must approve them before the examination can take place. Both bodies may suggest changes.
- The Dissertation Defense Committee, which must be approved by IDOC, should consist of at least three members of the of the student’s advisory committee, including the principal advisor. As with other doctoral dissertation defenses this committee must include an additional person from outside of Tufts familiar with the field, who is not a member of the dissertation working committee and is not associated with the student’s research.
Interdisciplinary Studies

The Center for Interdisciplinary Studies (CIS) administers the Interdisciplinary Studies major and the CIS Senior Thesis Option.

Interdisciplinary Studies Major

The Interdisciplinary Studies major offers students the opportunity to create a self-designed, individual concentration that draws on courses from at least two of the following six areas of study: humanities, arts, social sciences, natural sciences, mathematics (quantitative), and engineering.

Students proposing an Interdisciplinary Studies major must have a high degree of initiative and self-discipline. The Interdisciplinary Studies major consists of an integrated program of at least ten credits plus a two-semester thesis or honors thesis (for eligible students) or a substantial project comparable in scope to a thesis, including a written component. A student who wishes to pursue an Interdisciplinary Studies major must submit a detailed application describing the planned program of study. The student selects an advisory committee of three faculty members who support the application, including representatives from three departments in at least two of the six areas listed above. At least two of the committee members must be full-time members of the Arts and Sciences faculty with the rank of lecturer or above; at least one of the committee members must be a tenured or tenure-track member of the Arts and Sciences faculty. In consultation with this advisory committee, the student develops a rationale for the major, selects courses, and outlines the thesis plan. The proposal is reviewed for approval by the CIS Board or its designated subcommittee.

Note: Two credits used to fulfill another major may be used toward the Interdisciplinary Studies major; students may not triple major if one major is in Interdisciplinary Studies.

For specific information and application guidelines, visit the Center for Interdisciplinary Studies website: http://cis.tufts.edu.

CIS Senior Thesis

Arts, Sciences, and Engineering students who wish to write a senior thesis outside their major area of concentration may be eligible to write a CIS senior thesis. The student must satisfy the CIS Board or its designated subcommittee that the topic falls outside the purview of any department or interdisciplinary program and that significant course work and/or faculty-directed research relevant to the thesis topic has been accomplished. The student must assemble a committee of three faculty readers with expertise in the disciplines involved, one of whom will serve as the chair of the committee and be responsible for submitting the final grade. One member of the committee must be from a department or program in which the student is majoring. The proposed thesis topic must be approved by the CIS Board or its designated subcommittee. Application instructions and relevant timeline can be found on the CIS website.

Students who would like to be recommended for degrees with honors by a department or program that requires a thesis should be aware that a CIS thesis will not usually count as a substitute for an honors thesis within the department or program. However, once the thesis proposal is approved by the CIS Board or its designated subcommittee, eligible students can apply to the Thesis Honors Program by filing the appropriate paperwork at Dowling Hall. If the CIS thesis is to qualify as an honors thesis, the chair of the thesis committee must be a member of the department or program in which the student is majoring.

In addition to administering the Interdisciplinary Studies major and the CIS Senior Thesis, the Center for Interdisciplinary Studies provides a dynamic hub for a range of interdisciplinary academic programs at Tufts. For information about majors and/or minors offered by interdisciplinary programs, please see the relevant program website. The academic programs affiliated with the collective enterprise of the Center for Interdisciplinary Studies include:

Community Health
Environmental Studies
Film and Media Studies
International Literary and Visual Studies
International Relations
Judaic Studies
Latin American Studies
Leadership Studies
Medieval Studies
Middle Eastern Studies
Multimedia Arts
Peace and Justice Studies
Urban Studies
Women's, Gender, and Sexuality Studies

Other interdisciplinary programs at Tufts include:
Biochemistry
Biopsychology
Chemical Physics
Cognitive and Brain Sciences
Consortium of Studies in Race, Colonialism, and Diaspora (RCD)

For more information on these programs, students should consult the individual program website and/or program director.
International Literary and Visual Studies

CO-DIRECTORS:
Professor Charles Inouye, German, Russian, and Asian Languages and Literatures
Professor Isabelle Naginski, Romance Languages

The program in International Literary and Visual Studies makes possible the study of literature, film, and visual arts in an international context. ILVS students share an interest in literature, cinema, and the visual arts, which they approach in an interdisciplinary, multicultural way.

UNDERGRADUATE CONCENTRATION REQUIREMENTS

Language Preparation for the Major
Students are to have or to attain competency in one foreign language (to 122 or equivalent), and are strongly urged to begin the study of a second. (In some cases, depending on the student’s background, this second language could be English.)

Disciplinary focus
ILVS offers three tracks—literature, film, and the visual arts, which would include painting, photography, performance, etc.). A student focuses on one of these areas, but also does work in the other two.

Cultural areas
ILVS majors select a primary and a secondary area of study. This is usually a geographical area (Russia, Germany, Latin America, the Middle East), but it could be a conceptual area (the modern novel, postmodern theory). Normally, these areas reflect one’s language preparation—Japanese and Japan, Chinese and China—but this is not always the case. For example, a native speaker of French might choose French and Spanish as her languages, and Spain and Japan as areas of cultural study. Or someone just starting Chinese and interested in film might choose China as a primary area and American film as a secondary area. In all cases, ILVS requires the study of more than one culture.

A main focus
ILVS is both interdisciplinary and multicultural; therefore, the number of courses available to a student doing the major is large. For this flexibility to work to one’s advantage, each student should have a conceptual focus, developed in consultation with his or her major advisor. This might be a question about a certain cultural phenomenon or an aesthetic school, style, or problem: for example, “What is the relationship between art and politics?” or “How is art education handled in different cultures, and to what effect?” Alternatively, you might also focus on an interaction or common development in two or more cultures, or on a particular genre or form. A student’s conceptual focus should guide course selection and eventually lead to a senior thesis or project.

The senior year
A senior project is required. It can be a one-semester project (usually an independent study or a slightly enlarged seminar paper), or a two-semester senior honors thesis. The thesis could be a scholarly study, a translation, a film, a photo exhibit, or some other creative project.

To help consolidate your learning and to help prepare for the world beyond Tufts, ILVS majors should take the senior colloquium/thesis advising course their final semester.

Courses
The major consists of twelve courses, not counting those taken for language preparation.

The particular distribution of courses is determined by the disciplinary track selected by the student. All majors take a gate-way course particular to one’s track, a course on cultural theory, and a cross-cultural or gender-related course.

Otherwise, one takes a selection of courses that fits one’s designated cultural areas. At least one of the twelve courses should be either a seminar, an intensive course requiring a substantial integrative project, or independent study leading to a senior project or thesis.
Courses that might serve two categories of the requirements cannot be double-counted within the major. Any departures from the proportions or content of these categories must be approved by petition to a committee of core faculty. Here is the distribution of required courses for each of the three possible tracks.

**LITERATURE EMPHASIS**
A. National and ethnic literatures (six courses). The student must take six literature courses—four in the primary cultural area and two in secondary area—preferably in the foreign language being studied.

B. Visual arts and/or film (two courses). The student must take two courses in film or the visual arts (normally, one in each cultural area, chosen from course lists on [http://ase.tufts.edu/ilvs/requirements/courses.htm](http://ase.tufts.edu/ilvs/requirements/courses.htm)).

C. Cross-cultural and/or gender-oriented literary or visual studies (two courses). The student must take two courses of a cross-cultural or gender-oriented nature in a literary or visual art or from film and visual arts courses (chosen from course lists on [http://ase.tufts.edu/ilvs/requirements/courses.htm](http://ase.tufts.edu/ilvs/requirements/courses.htm)).

D. Literary and cultural theory (two courses). The student must also complete one semester of literary theory and one semester of cultural theory (chosen from course lists on [http://ase.tufts.edu/ilvs/requirements/courses.htm](http://ase.tufts.edu/ilvs/requirements/courses.htm)).

**FILM EMPHASIS**
A. National and ethnic literatures (three courses). The student must take three literature courses, two in the primary culture area and one in the secondary area.

B. Film (five courses). The student must take five courses in film, normally including one in the primary cultural area and another in the secondary area. The student may substitute, for one of the five courses, a course in visual arts or a studio course in some domain of filmmaking (screenwriting, directing, acting, etc.) (chosen from the course lists on [http://ase.tufts.edu/ilvs/requirements/courses.htm](http://ase.tufts.edu/ilvs/requirements/courses.htm)).

C. Cross-cultural and/or gender-oriented literary or visual studies (two courses). The student must take two courses of a cross-cultural or gender-oriented nature in a literary or visual art, or from film and visual arts courses (chosen from course lists on [http://ase.tufts.edu/ilvs/requirements/courses.htm](http://ase.tufts.edu/ilvs/requirements/courses.htm)).

D. Film theory and cultural theory (two courses). The student must take one course in film theory plus one course in cultural theory (chosen from course lists on [http://ase.tufts.edu/ilvs/requirements/courses.htm](http://ase.tufts.edu/ilvs/requirements/courses.htm)).

**VISUAL STUDIES EMPHASIS**
A. National and ethnic literatures (three courses). The student must take three literature courses, two in the primary cultural area and one in the secondary area.

B. Visual arts (five courses). The student must take five courses in visual arts, normally including one in the primary cultural area and one in the secondary area. The student may substitute, for one of the five courses, a course in film or two studio courses in a visual art (drawing, painting, sculpture, filmmaking, etc.) (chosen from the course lists on [http://ase.tufts.edu/ilvs/requirements/courses.htm](http://ase.tufts.edu/ilvs/requirements/courses.htm)).

C. Cross-cultural and/or gender-oriented literary or visual studies (two courses). The student must take two courses of a cross-cultural or gender-oriented nature in a literary or visual art or from film and visual arts courses (chosen from course lists on [http://ase.tufts.edu/ilvs/requirements/courses.htm](http://ase.tufts.edu/ilvs/requirements/courses.htm)).

D. Visual and cultural theory (two courses). The student must take one course in visual theory and one course in cultural theory (chosen from course lists on [http://ase.tufts.edu/ilvs/requirements/courses.htm](http://ase.tufts.edu/ilvs/requirements/courses.htm)).

For more detailed information, please visit the website [http://ase.tufts.edu/ILVS](http://ase.tufts.edu/ILVS).
International Relations

DIRECTOR:
To Be Announced

CORE FACULTY:
Professor Ina Baghdiantz-McCabe, History
Professor Nancy Bauer, Philosophy, Dean of SMFA
Professor Marcelo Bianconi, Economics
Professor Gregory Carleton, Russian
Professor Ujjayant Chakravorty, Economics
Professor Gregory Crane, Classics
Professor Robert Devigne, Political Science
Professor Ioannis Evrigenis, Political Science
Professor Leila T. Fawaz, History
Professor Gerard Gasarian, French
Professor David M. Guss, Anthropology
Professor David Gute, Civil and Environmental Engineering
Professor Brian Hatcher, Religion
Professor Hosea Hirata, Japanese
Professor Bruce Hitchner, Classics
Professor Charles Shiro Inouye, Japanese
Professor Yannis Ioannides, Economics
Professor Ayesha Jalal, History
Professor Vida Johnson, Russian
Professor Paul Joseph, Peace and Justice Studies/Sociology
Professor David Locke, Music
Professor Lisa Lowe, English
Professor Beatrice Manz, History
Professor Jose Antonio Mazzotti, Spanish
Professor Margaret McMillan, Economics
Professor Malik Mufti, Political Science
Professor H. Adlai Murdoch, Romance Languages
Professor Isabelle Naginski, French
Professor Susan Napier, Japanese
Professor Pedro Angel Palou, Romance Languages
Professor Jeanne M. Penvenne, History
Professor Peter Probst, Art and Art History
Professor Daniel J. Richards, Economics
Professor Hugh Roberts, History
Professor Enrico Spolaore, Economics
Professor Vickie Sullivan, Political Science
Professor Reed Ueda, History
Professor Peter Winn, History
Professor Jonathan Wilson, English
Professor Christiane Zehl Romero, German
Professor Xueping Zhong, Chinese

Associate Professor David Art, Political Science
Associate Professor Gloria Ascher, German/Judaic Studies
Associate Professor Cristelle Baskins, Art and Art History
Associate Professor Amahl Bishara, Anthropology
Associate Professor Drusilla Brown, Economics
Associate Professor Consuelo Cruz, Political Science
Associate Professor Heather Curtis, Religion
Associate Professor Richard C. Eichenberg, Political Science
Associate Professor David Ekbladh, History
Associate Professor Elizabeth Foster, History
The IR Program offers a rigorous plan of study for undergraduate students with a primary interest in international relations. The field of international relations includes the study of international and regional systems; the foreign relations of states, including their political, military, economic, and environmental policies; the sources of international conflict and cooperation; the domestic and trans-national interests and actors that influence states; and the historical, political, social, cultural, ethical, and humanistic traditions that impinge on the international relations of particular states or regions.

The IR Program is governed by an executive committee representing the departments and programs that serve the major. All majors select an academic advisor who is a member of the international relations core faculty.

First-year students who anticipate majoring in international relations should read the concentration requirements below. Generally, prospective majors in the first year should select a program of study that includes a foreign language and perhaps the first course in international relations (Political
Science 61) and in economics (Economics 5). The major is usually declared during the sophomore year, although first-year students are encouraged to consult with the program in planning their course of study, especially if they plan to spend all or part of their junior year abroad.

The IR Program awards four prize scholarships and academic awards: the John S. Gibson Prize, the Distinguished Achievement Award in International Relations, the International Relations Research Scholars Award, and the Anne E. Borghesani Memorial Prize. The International Relations Research Scholars Award is designed to enable promising IR majors to conduct high-level, original research under the supervision of IR core faculty members in the summer before their senior year. The Borghesani Prize, open to sophomores and juniors from any concentration, is intended to help defray the costs of study, research, or community service abroad that adds an international dimension to the student's program of study.

Majors in international relations may take advantage of study abroad opportunities and participate in the Tufts-in-Talloires summer session, where international relations courses are generally offered. Students who study abroad with Tufts and/or non-Tufts programs may credit qualified courses toward the major, provided that they have obtained approval from the IR Program office, have completed the appropriate transfer credit preapproval process, and have submitted appropriate documentation to the IR Program office in Cabot 605. Students should consult with their advisor and the IR Program to make sure course work fulfills requirements. Students who study abroad in either Tufts programs or non-Tufts programs should carefully review all program policies regarding requirements and the number of courses that can be taken beyond the Medford campus (see more information below).

International relations majors may wish to note the combined-degrees program offered by the College of Liberal Arts and the Fletcher School of Law and Diplomacy. Qualified juniors may apply to the Fletcher School after they have completed and received grades in twenty courses. Details of this highly competitive dual-degree program are described in this bulletin under Combined-Degrees Programs; an interview with the Fletcher admissions office is required.

UNDERGRADUATE MAJOR REQUIREMENTS
The international relations major requires twelve courses comprised of five core courses and seven courses from one of six thematic concentrations chosen by students. One research methods class is required effective for the Class of 2018 and beyond. A grade of C- or better is required for a course to count for the IR major. No more than three courses taken abroad (including on Tufts Programs Abroad) may be applied toward the twelve-course major (only one of which may be applied toward the IR core requirements). The IR capstone requirement (upper-level seminar, directed research or senior thesis) must be completed on the Tufts Medford campus. Additionally, the IR Program requires proficiency in a language other than English. Details regarding the requirements are as follows.

Language Requirement
The IR major requires oral and written proficiency in a language other than English. Proficiency is defined as successful completion of eight semesters (or the equivalent) of university-level language instruction. All students wishing to major in international relations are required to comply with this requirement. Courses used to fulfill this requirement may not overlap with the core or thematic concentration requirements.

Core Requirements (five courses)
The core requirements constitute the foundation of knowledge that is needed by all majors in International Relations, regardless of thematic concentration. They are composed of broad introductory courses that cover the major themes and debates within each discipline on the study of international affairs. Core courses constitute a major element in establishing a coherent sense of IR identity and community. The IR Program strongly encourages students to take all core courses at Tufts.

Political Science 61 Introduction to International Relations
Economics 5 Principles of Economics
One course in international economics*
One course in theories of society and culture*
One course in the historical dimension*

*See IR website for more details.
Thematic Concentration Requirement (seven courses)
Thematic concentrations are designed to provide students with substantial, in-depth and focused study of an aspect of international affairs. All majors must choose one of the following six thematic concentrations and complete the course requirements within that concentration with no less than seven total courses. One of the seven thematic concentration courses must also include a research methods course (such as INTR 91, INTR 92 or several other options). Moreover, the normal expectation is that no more than three of the seven courses in each concentration may be an introductory-level course, and that one must be a capstone research course (seminar, honors thesis, or directed research).

1. REGIONAL AND COMPARATIVE ANALYSIS
Choose one of the following:
   Africa
   East and Southeast Asia
   Europe and the former Soviet Union
   Latin America
   Middle East and South Asia

2. INTERNATIONAL ECONOMICS
Choose one of the following:
   International economics and trade
   International economics and finance
   International economics and environment
   International economics and development

3. GLOBAL HEALTH, NUTRITION, AND THE ENVIRONMENT

4. INTERNATIONAL SECURITY

5. GLOBALIZATIONS

6. IDENTITY

Descriptions of the thematic concentrations, detailed program requirements and policies, and a complete list of courses that satisfy the IR major are available on the IR website as follows:
http://ase.tufts.edu/ir.
Italian Studies

(FOR DEGREE REQUIREMENTS, SEE ROMANCE LANGUAGES.)
Japanese

(FOR DEGREE REQUIREMENTS, SEE GERMAN, RUSSIAN, AND ASIAN LANGUAGES AND LITERATURES.)
Judaic Studies

(for degree requirements, see german, russian, and asian languages and literatures.)
Latin American Studies

DIRECTOR:
Associate Professor Nina Gerassi-Navarro, Romance Languages

Latin America is increasingly important in the world and for the United States in particular. The study of our hemispheric neighbors, the area of origin of our country’s largest minority group according to the 2010 census, is important in itself, and also relevant for the understanding of larger international issues. Latin American Studies is an interdisciplinary program that encourages students to integrate the varying disciplinary perspectives of the arts, literature, social sciences, and history, along with the study of the languages of the area, into a coherent view of Latin America.

Major in Latin American Studies
The major in Latin American Studies offers students the opportunity to combine the approaches of several academic disciplines in a focused study of the region. In recent decades, Latin America has become a field of rapid development in the arts, humanities and social sciences. The major’s interdisciplinary approach integrates historical, social, political, economic and cultural perspectives at both national and regional levels. The program of study culminates in an independent interdisciplinary capstone project on a Latin American subject or in a senior thesis or senior seminar.

Requirements for completing the Latin American Studies major are 11 courses and a five-semester language study. Required courses include courses in history, social sciences, literature and the arts, plus foundational courses, as well as a research seminar or thesis or independent project. At least one of the courses should focus on indigenous peoples, and at least one course must focus on pre-20th-century Latin America. A Latino Studies course may count as one of the elective courses. A grade of C- or better is required for a course to count for the major.

Minor in Latin American Studies
There are three requirements for completing an interdisciplinary minor in Latin American studies.
1) Students should study one of the region’s languages for three years (e.g., Spanish 22) or the equivalent. Normally, this language will be Spanish or Portuguese, but others (e.g., Quechua) may be substituted with the approval of the director.
2) Students must complete at least five credits in Latin American Studies, which should include at least one course from each of the three disciplinary areas: arts and literature, social sciences, and history. Students may count as many as two courses transferred from other institutions or used to satisfy another concentration requirement toward the minor. This limit does not apply to courses taken at Tufts Programs Abroad. A grade of C- or better is required for a course to count for the minor.
3) Students must complete a capstone project that integrates at least two of the three disciplinary areas of the minor (arts and literature, social sciences, and history). This project may be a written work, a performance, or some other creative work for which the student will receive one course credit. Normally, the project will emerge out of one of the courses that the student takes for the minor and will be advised by the instructor of that course. The student must also form a committee of at least two faculty members to evaluate the project, which would include the project’s faculty advisor and a faculty member from the other disciplinary area involved in the project. The format is flexible, but the content must conform to these guidelines. Normally, a student will complete the project in the final semester at Tufts. (See Interdisciplinary Minor Program for details.)

APPROVED COURSES
Each semester an updated list of current Latin American studies courses is available from the director. Seminars and other courses on the region may be offered from time to time and credited toward the minor or major. Students may also petition the director to credit courses not included in the list.

For more detailed information, please visit the website http://ase.tufts.edu/latinamericanstudies.
The interdisciplinary minor in Latino Studies is one of the five programs within Tufts’ Consortium of Studies in Race, Colonialism, and Diaspora (RCD). The minor requires six credits. The minor provides the opportunity to study Latinas/os within the U.S. sociopolitical and cultural context, as well as a framework for understanding this population’s historical connections to Latin America. Courses explore the impact of U.S.-Latin American relations in shaping migration flows, as well as the impact of colonialism and war, racism, inequality, and cultural, social, and political marginalization on U.S. Latino experiences. Our curriculum also underscores the vibrant contributions of Latinas/os in U.S. history and social life, in music, theater, film, the visual arts, literature, and popular culture.

The following courses are required:

- One introductory survey course focused on U.S. Latinos from the list online.
- One Latin American survey course from the list online or an approved equivalent.
- One survey course in comparative race relations in the U.S. context from the list online or an approved equivalent.
- One core course with at least 50 percent Latino content. With approval of Latino Studies director, this requirement can be met by taking a Latino Studies course from one of Tufts’ consortium partners.
- One elective course relevant to Latino Studies with substantial and/or relevant Latino content, in which student must do a substantial project or paper on a Latino topic. An independent study course with a Latino Studies faculty on a Latino Studies topic may also count.
- The capstone experience (LST198): All students must participate in a capstone experience, developed in consultation with the program director, that may involve independent research or work in one of Boston’s Latino communities. The capstone project must culminate in a written paper, performance, or oral presentation, which integrates the knowledge and methodologies of the disciplines involved. The capstone may also be based, in part, on a documented internship and will then require a paper based on the internship experience to be evaluated by the program director or an associated program faculty member.

**NOTE:** Students should check the Latino Studies website for a list of courses that meet these requirements and/or meet with the director of the minor. All courses taken for the Latino Studies minor program must be taken for a letter grade. A maximum of two credits from the minor may be counted toward a major or majors; up to two credits may be used for distribution requirements. Also, one language course above the intermediate level, Spanish for Heritage Speakers (Spanish 23), or Portuguese 1 or 2 can count as an elective course.

Students interested in pursuing a Latino Studies Minor should register with Associate Professor Adriana Zavala, Art and Art History, 617-627-2423, adriana.zavala@tufts.edu; or with Cynthia Sanders, Program Administrator, 110 Eaton Hall, 617-627-2311, Cynthia.Sanders@tufts.edu

For more detailed information, please visit the website [http://ase.tufts.edu/latinostudies](http://ase.tufts.edu/latinostudies).
Leadership Studies

DIRECTOR:
Mindy Nierenberg, Tisch College of Citizenship and Public Service

Leadership Studies is an interdisciplinary field that offers students the opportunity to study leadership theory from a multi-disciplinary perspective. The field of Leadership Studies connects with any major at Tufts, and provides students ways to integrate academic, personal, and experiential growth as leaders. Students are encouraged to explore various leadership models while developing their own leadership style, building skills and knowledge that will benefit them while at Tufts and in their lives after graduation. Scholarship in Leadership Studies analyzes the influence of historical, political, economic, psychological, and technological forces on effective leadership and leadership models. Leadership Studies at Tufts places particular emphasis on leadership that bridges cultural divides and furthers understanding of diverse models of leadership. Leadership is examined not only on an individual level, but also regarding the role of organizations, nonprofit, for-profit, governmental, and educational, in complex societies.

Leadership Studies at Tufts develops creative, analytical and practical skills and attitudes. Skill development is further encouraged through courses emphasizing public speaking, cross-disciplinary and cross-cultural communication and team building, negotiation, mediation, and creative problem solving. The Leadership Studies minor also requires students to analyze issues relating to ethics, values and decision making, organizational behavior, power and power relations, and policymaking. In these realms, the minor also allows for a focus on civic leadership, and the importance of the development of the knowledge, skills and values crucial to effective positive change on local, domestic, and global communities.

INTERDISCIPLINARY MINOR
Students pursuing the interdisciplinary minor in Leadership Studies take a total of six courses at 5.5 credits. Two of these must be Tier 1 core courses and two must be drawn from the list of Tier 2 courses. The fifth course may be selected from Tier 1 or Tier 2. The director of the Minor in Leadership Studies advises on course selection to fit each student’s interests and to establish the basis for the Tier 3 capstone senior project. All courses must be taken for a letter grade. As a capstone, students must complete a Tier 3 senior project. Here, students put theory into practice and take a seminar course in which they reflect on their experience in the context of their leadership courses and readings throughout the capstone. Students in the leadership minor consider how the courses they propose to take and their leadership experience constitute a coherent whole.

LEADERSHIP STUDIES CURRICULUM
The Leadership Studies curriculum consists of many courses drawn from across the range of departments and disciplines at Tufts that either directly or indirectly addresses the issues of leadership. The director is charged with maintaining an appropriate selection of courses in Tier 1 and 2 (including evaluating student petitions to include additional courses for credit toward the minor).

Tier 1 Courses
The courses in Tier 1 develop the intellectual underpinnings of the Minor in Leadership Studies. These courses introduce the basic principles of leadership and introduce theories of leadership that have been developed in a number of different disciplines. Students are highly encouraged to take “Introduction to Leadership Studies”, offered through the Political Science department, as one of their Tier 1 courses.

Tier 2 Courses
Courses in Tier 2 allow students to round out their study of leadership. These courses widen the disciplinary foundations of the study of leadership.

Tier 3 Course
To complete the minor, students must engage in a practical leadership capstone experience. Students must meet with the director of the program to develop a prospectus describing the goals, challenges, and objectives of their leadership experience. Students participating in programs such as the Tisch Scholars Program for Citizenship and Public Service, the IGL Synaptic Scholars Program, and Resident Assistants may apply to have that experience count as the capstone, and other campus leadership experiences may constitute the basis of their applications as well. Examples of capstone experiences for the Leadership Studies Minor have
included service as a Reserve Officers Training Corps member, captain of an athletic team, or executive board member of a student organization. Structured reflection is a key element of the capstone experience. Students will be required to meet with other students pursuing the capstone in a half-credit pass-fail seminar. For the seminar, they will write a paper linking their experience to the theories and issues covered in their coursework.

As an alternative, and with permission of the director of the program, students can complete Tier 3 by undertaking a senior thesis on leadership.
Management of Community Organizations

FACULTY ADVISOR:
Barbara Parmenter, Urban and Environmental Policy and Planning

Are you one of those who, because of your deep commitment to an important public issue, started in community organizing or perhaps as a direct service provider—and who find yourself today as an “accidental manager” of a community organization? Without the benefit of formal training or theoretical grounding, you may find yourself in uncharted territory running a growing, increasingly complex organization.

The certificate in Management of Community Organizations (MCO) may be for you. It’s a graduate-level program that provides management training within the framework of social, economic and political values that shape the nonprofit sector. The program’s goal is to train people in effective management who are committed to social policy and wish to work at the community level. The certificate is offered by the graduate Department of Urban and Environmental Policy and Planning.

The certificate requires the completion of four courses—one core and three electives—that address such issues as financial analysis, program evaluation, urban and social policy, fundraising, and conflict resolution.

The program is open to individuals with a bachelor’s degree and is especially appropriate for new managers of community organizations, those with experience in the field who seek additional management training, midcareer professionals interested in pursuing community work, and individuals who wish to start a new agency or program.

For more information, contact the program administrator, Angela Foss, at 617-627-2320 or visit the website http://as.tufts.edu/uep/programs/certificate.
Manufacturing Engineering Certificate Program

FACULTY ADVISOR:
Professor Anil Saigal, Mechanical Engineering

As the United States continues to compete in global markets, the need for manufacturing engineers who can design, build, operate, and manage competitive production systems has never been greater. Excellence in design and production, especially knowledge of CAD, CAM, CNC machining, and robotics, is essential as industries strive to reduce labor costs, increase productivity and profitability, tighten performance standards, and improve quality.

The Department of Mechanical Engineering offers a four-course graduate-level certificate in manufacturing engineering. The program is offered on a part-time, non-degree basis for students seeking professional training in manufacturing engineering. In most cases, courses taken as a certificate student can be transferred to a degree program. Graduate students may also pursue the certificate as a concentration within their degree. The program is open to students with a bachelor’s degree and a background in engineering, science, or mathematics.

For more information, contact the program administrator, Angela Foss, at 617-627-2320 or visit the website at http://engineering.tufts.edu/me/graduate/certManufacturing.htm.
Our experience up to date justifies us in feeling sure that in Nature is actualized the ideal of mathematical simplicity.
— Albert Einstein

pencer Lecture, Oxford, 1933

UNDERGRADUATE CONCENTRATION REQUIREMENTS

Option I: Major in Mathematics
To major in Mathematics, a student must take ten courses beyond Calculus II (Mathematics 32, 36, or 39). These courses must include Mathematics 42 or 44, Mathematics 70 or 72, Mathematics 135, Mathematics 145, Mathematics 136 or 146, two more 100-level mathematics courses, and three electives. The electives may include mathematics courses numbered 50 or above and up to two approved courses in related fields. Majors are advised to complete Mathematics 42 or 44 and Mathematics 70 or 72 by the end of their second year.

Students in the School of Engineering may, with certain exceptions, choose mathematics as a second area of concentration. To do so, a student must notify the dean of engineering through the Department of Mathematics at least one semester before graduation. The student must complete a program that simultaneously satisfies the conditions for a degree from the School of Engineering and the concentration requirements of the Department of Mathematics.

Option II: Major in Applied Mathematics
To major in Applied Mathematics, a student must take 13 courses beyond Calculus II (Mathematics 34, 36,
or 39). These courses must include Mathematics 42 or 44; Mathematics 51; Mathematics 70 or 72; Mathematics 87, 158, 135, and 136; one of Mathematics 145, Comp/Math 61, Comp 15, or Comp/Math 163; one of the following three sequences: Mathematics 126/128, 151/152, or 161/162; one of Mathematics 126, 128, 151, 152, 161, or 162 (excluding the sequence referred to in the last requirement); and two electives. Mathematics courses numbered 61 or above are acceptable electives. With the approval of the Mathematics Department, students may also choose as electives courses with strong mathematical content that are not listed as Mathematics courses. Majors are advised to complete Mathematics 42 or 44, Mathematics 70 or 72, and Mathematics 87 by the end of their sophomore year.

UNDERGRADUATE MINOR PROGRAM
To minor in mathematics, a student must take six courses in the department beyond the level of Calculus II (Mathematics 34, 36, or 39). These must include Mathematics 42 (or 44) and 72 (or 70), as well as Mathematics 135 or 145 (or both).

UNDERGRADUATE COURSES
Please note: Students who wish to begin calculus should register for either Mathematics 30, 32, or 39. Those interested in computer science, engineering, mathematics, or the physical sciences should begin the three-course sequence Mathematics 32, 34, 42 or the two-course accelerated honors sequence Mathematics 39, 44. Other combinations of these courses may not be granted full credit (see the separate course descriptions). Mathematics 4, 10, 14, 15, 16, 19, and 30 do not count toward a degree in the School of Engineering.

Students will receive half credit (with grade) for passing Mathematics 32 after receiving credit for Mathematics 30. Mathematics 32 must be taken at Tufts and for a grade in order to obtain this extra half credit. The extra half credit will not count toward the mathematical sciences distribution requirement. Mathematics 30 may not be taken for credit after receiving credit for Mathematics 32.

Course recommendations
Students who take Mathematics 70 instead of 72 are advised to also take another course above 51 to prepare for the proofs required in Mathematics 135 and 145.

Mathematics majors interested in graduate school in applied mathematics are advised to major in applied mathematics. The requirements of that major reflect the appropriate preparation for graduate study in this field.

Mathematics for majors interested in graduate school in pure mathematics: For mathematical depth, we recommend Mathematics 136, 146, and 158. We recommend students take as many 100-level and higher courses as possible.

We also recommend that students interested in graduate school in pure or applied mathematics do research in mathematics, such as through an NSF Research Experience for Undergraduates (REU) Program or with a professor at Tufts.

Mathematics for majors interested in actuarial science: We recommend Mathematics 51, 161, 162, and 136; economics courses such as EC 105, 107, 108, 150, and 152; and ES 152 and programming.

Mathematics for majors interested in computer science: We strongly recommend Mathematics 61, 63, 126, and 128, and we recommend 146, 161, 162, as well as Computer Science 160 and 170 plus programming.

Mathematics for majors interested in economics: We recommend Mathematics 51, 161, 162, and 136, as well as EC 107–8. We also recommend students take Comp 11.


Mathematics for majors interested in careers in science: We recommend that students consult professors in the specific science department as well as our department.

Mathematics for majors interested in teaching high school: We recommend Mathematics 61, 63, 112, 146, and 161, and education courses. We encourage students to take Mathematics 136 or 158, or computer science, if possible.
GRADUATE PROGRAM
The Department of Mathematics offers programs leading to the degrees of master of science and doctor of philosophy. Applicants are expected to have mathematical preparation at least equivalent to that of an undergraduate major in mathematics, including courses in analysis and algebra. Many students fulfill the master’s degree requirements and obtain a master’s degree in the course of their doctoral studies.

Master’s Degree
To qualify for the master’s degree, a student completes an approved program of at least nine courses in total, with at least three courses numbered above 200, with the following guidelines to insure breadth:

a. Three courses: one each in three of the distinct individual areas 1–5 given below, two of which are at the 200 level—a full pass on the corresponding Ph.D. qualifying examination would count as the course requirement here.

b. Four courses: Any from areas 1–6

c. Two courses: Elective courses which can be any course numbered above 112

Areas:
1. Analysis: 211, 212, 213, 136
2. Algebra: 215, 216, 146
4. Numerical analysis: 226, 228, 128
5. Partial differential equations: 251, 252, 152
6. Other: 158, 162, 163, 170, any course above 200

Any part of this requirement may be fulfilled by equivalent courses with prior approval by the Mathematics Department Graduate Committee. Master’s students must complete at least two courses (not counting thesis) each semester until five courses counting towards the degree are satisfactorily completed, unless this requirement is waived by the graduate committee.

In addition, students are required to participate in one of our active research seminars for two terms as well as the colloquium on a regular basis.

Master’s Thesis Option
A student may write an expository paper on a specific topic in mathematics under the direction of a member of the department and upon completion present it before a committee of two or more faculty members. The writing of the thesis can be counted as the two elective courses from the nine courses for the course requirement via numbers 295 and 296.

Doctor of Philosophy
A doctoral student must pass oral qualifying examinations in three out of the five fields of analysis, algebra, geometry/topology, partial differential equations and numerical analysis by the end of the second year.

The choice of three fields must be approved in writing by the graduate director based upon a discussion with the student by the end of his or her first semester at Tufts. This choice can be modified in consultation with the Graduate Committee.

Within one year after completion of the oral examinations, the student must pass a candidacy examination on material studied in preparation for work on a dissertation.

The major task of a doctoral student is to write a dissertation under the direction of a department member. This must be a substantial original contribution to the field of the student’s specialty and must meet standards of quality as exemplified by current mathematical research journals.

At least one semester’s teaching experience at Tufts is required.

For more detailed information, please visit the website http://math.tufts.edu.
Mechanical Engineering

Professor Chris Rogers, Department Chair; Robotics, musical instrument design, fluid mechanics, and engineering education
Professor Mark Kachanov, Solid Mechanics, Fracture mechanics, micro-mechanics of materials
Professor William Messner, John R. Beaver Professor; Automatic control systems with an emphasis on applications to data storage systems, robotics, microfluidics, and biological systems and instrumentation
Professor Anil Saigal, Materials engineering, manufacturing processes, quality control
Professor Igor Sokolov, Condensed matter, soft condensed matter and biomedical research, energy-related materials and sustainability, surface science and engineering

Associate Professor Behrouz Abedian, Fluid mechanics, electrokinetics and thermal-fluid systems
Associate Professor Luisa Chiesa, Sustainable energy, superconducting materials
Associate Professor Marc Hodes, Transport phenomena; apparent slip, aerogels
Associate Professor Douglas M. Matson, Solidification processes, thermal manufacturing, machine design
Associate Professor Jason Rife, Robotics, dynamics and controls
Associate Professor Robert White, Micro and Nanosystems (MEMS/NEMS), Micro/Nano-Manufacturing, Electromechanical Systems, Sensors, Acoustics, Vibrations

Associate Professor Jeffrey Guasto, Microscale transport, bio-fluid mechanics, microfluidics
Assistant Professor Erica Kemmerling, Medical engineering, fluid mechanics
Assistant Professor Kristen Wendell, Engineering education, product design
Assistant Professor Iryna Zenyuk, Electrochemistry, thermodynamics, fluid mechanics, renewable energy

Senior Lecturer and Research Assistant Professor Gary G. Leisk, Machine design, non-destructive testing

Professor of the Practice Daniel Hannon, Human factors in product design
Professor of the Practice Pratap Misra, GPS, emerging satellite navigation systems
Professor of the Practice Michael Wiklund, Human factors in product research and design
Professor of the Practice Michael A. Zimmerman, Material science, thermal manufacturing

SECONDARY APPOINTMENTS:
Adjunct Professor Vincent Manno, Provost and Dean of the Faculty, Professor of Engineering, Franklin W. Olin College of Engineering, Computational thermal-fluid dynamics, power generation, electronics thermal energy management, and manufacturing processes
Adjunct Professor Holly Taylor, Professor and Director of Graduate Program, Psychology, Tufts University Human Factors, situation models, spatial cognition and comprehension
Adjunct Associate Professor Thomas Vandervelde, Associate Professor, Electrical and Computer Engineering, Tufts University, Interaction of light with matter, physics of nanostructures (semiconductor photonics and electronics) and interfaces, energy materials

Mechanical engineering is a rich and versatile profession that encompasses invention, design, analysis, and manufacturing of mechanical components and systems. Broadly speaking, mechanical engineering is the branch of engineering that encompasses the generation and application of heat and mechanical power. In other words, mechanical engineering is all about the analysis, design and manufacturing of systems in motion. It spans both mature, well-established industries such as automotive, aerospace, shipping, power, heating and cooling, and machinery and well as new and emerging technologies such as robotics, medical devices, and micro and nano devices. Mechanical engineering is also a highly collaborative discipline with many opportunities to work with colleagues in other disciplines.
The faculty in the Department of Mechanical Engineering offer courses in the core disciplines of Thermal Fluid Systems, Material Mechanics and Processing, Robotic, Aeronautic and Automated Systems, and Product Design and Human Factors. Their research is in four areas of specialization:

1. *The world of the very small*, where we control materials all the way down to the atomic level, and also build functional devices at the micro- and nano-scale, allowing new avenues of innovation in materials, sensors and actuators. We build micro and nano electro-mechanical systems (MEMS/NEMS) such as microphones, ultrasound sensors, and aerodynamic measurement systems. We develop hydrophobic coatings and nano-pattered surfaces for heat transfer, develop bio-sensing systems for detecting cancer, and nano polished surfaces to prevent bacterial growth. We also develop models of how things fracture.

2. *The world of biological systems*, where we look at how cells move in micro-fluidic systems or how blood flows in our veins and arteries. Our human factors group helps improve the design of future medical equipment while the soft robotics group develops biologically inspired robots using highly compliant materials.

3. *The world of sustainable energy*, where we focus on systems that generate, store, convert and consume power efficiently and consciously. This includes power generation, pyro-thermal materials processing, electronics thermal management, hydrogen cell energy storage, next generation battery design, and superconducting materials for energy transmission.

4. *The world of the human brain*, where we examine how humans learn to engineer and interact with technology. We use that information to develop the next generation of educational technologies. Our students in mechanical engineering and human factors collaborate with the departments of education, child development, and psychology to better understand how we learn. This knowledge is leveraged into working prototypes and products through our partnerships with industry.

The mission of the Department of Mechanical Engineering is to provide educational experiences that give students a sound basis for professional practice and a career of lifelong learning. Each program has specific objectives, but the common goal is to learn fundamental principles of mechanical engineering, to master engineering methods to solve challenging technical problems, and to communicate these solutions to the technical and nontechnical community. The department offers programs that are recognized as distinctive in their combination of technical quality, diverse areas of research, and attention to the individual.

**UNDERGRADUATE PROGRAM**

The undergraduate curriculum is based on a strong foundation in the physical, mathematical, and engineering sciences and enriched with courses in the humanities and social sciences. This skill set is augmented with hands-on laboratory and practical design experiences. Students select upper-level elective courses to offer exposure to a wide range of advanced and applied courses in thermal-fluid sciences, design methodology, engineering education, materials and materials processing, manufacturing, applied mechanics, robotics, and system automation and control. This provides students with a broad intellectual foundation upon which to build future careers in advanced engineering education and research; engineering practice; or non-engineering professional training in business, education, law, and medicine.

The Department of Mechanical Engineering offers two undergraduate degree programs leading to the undergraduate degrees of Bachelor of Science in Mechanical Engineering (B.S.M.E.) and Bachelor of Science (B.S.). The B.S.M.E. program is accredited by the Engineering Accreditation Commission of ABET (www.abet.org). Of the thirty-eight course credits required for the professional degrees accredited by the Engineering Accreditation Commission of ABET, a minimum of 9.5 course credits must be completed in college level math and basic science subjects appropriate to the discipline and a minimum of 14.5 course credits must be completed in Engineering topics, consistent with ABET general and program criteria. The B.S.M.E. program qualifies graduates for the Fundamentals of Engineering (FE) examination, which is the first step toward registration as a licensed professional engineer.

**Bachelor of Science in Mechanical Engineering**
Consistent with the requirements for ABET accreditation, the objectives of the B.S.M.E. program are presented here. We expect that graduates of the B.S.M.E. program will:

1. Integrate fundamental engineering, mathematics, and science principles to solve engineering or other professional challenges in an interdisciplinary environment.
2. Develop successful engineering or professional careers, either directly after an undergraduate degree or after pursuing graduate studies.
3. Communicate both technical and non-technical principles to a wide range of audiences.
4. Demonstrate leadership both through their individual efforts and through the roles attained within their respective organizations.

With the assistance of a faculty advisor, students should individually plan a program and, if desirable, modify that program each term as their experience and plans develop. In consultation with their advisors, students select a course of study that not only satisfies program requirements but also reflects their unique educational objectives.

CORE PROGRAM:
Freshman Year
FALL TERM
Introductory Engineering 1 Intro Engineering Elective
Mathematics 32 Calculus I
Physics 11 General Physics I
English 1 Expository Writing

SPRING TERM
Engineering Science 2 Introduction to Computing in Engineering
Mathematics 34 (or 36) Applied Calculus II
Chemistry 1 Chemical Fundamentals
Humanities/Arts or Social Science elective

Sophomore Year
FALL TERM
Engineering Science 3 Introduction to Electrical Systems
Engineering Science 5 Introduction to Mechanics—Statics and Dynamics
Mathematics 42 Calculus III
Physics 12 or Chemistry 2 General Physics II or Chemical Principles
Humanities/Arts or Social Science elective

SPRING TERM
Engineering Science 7 Thermodynamics
Engineering Science 9 Applied Mechanics—Strength of Materials
Mechanical Engineering 1 Mechanical Design and Fabrication
Mathematics 51 Differential Equations
Foundation elective

Junior Year
FALL TERM
Engineering Science 8 Fluid Mechanics
Mechanical Engineering 25 Engineering Materials
Mechanical Engineering 37 Dynamics and Vibrations
Mechanical Engineering 42 Machine Design II
Natural Science elective

SPRING TERM
Mechanical Engineering 16 Heat Transfer
**Mechanical Engineering 18** Instruments and Experiments  
**Mechanical Engineering 80** System Dynamics and Controls  
Probability, Statistics, or Numerical Methods  
Humanities/Arts or Social Science elective

**Senior Year**  
**FALL TERM**  
**Mechanical Engineering 43** Senior Design Projects  
Mechanical Engineering concentration elective  
Foundation elective  
Humanities/Arts or Social Science elective  
Free elective

**SPRING TERM**  
Mechanical Engineering concentration elective  
Mechanical Engineering concentration elective  
Mechanical Engineering concentration elective  
Humanities/Arts or Social Science elective  
Free elective

The above courses, in conjunction with the courses taken in the first year, satisfy the following distribution requirement:

1. A total of ten credits in introductory engineering sciences: four courses in the natural sciences (labeled in SIS as SoE-Natural Sciences), including Physics 11, Chemistry 1 or 16, and either Physics 12 or a second course in chemistry; four courses in mathematics, comprising Mathematics 32, 34 (or 36), 42, and 51; and two credits in introductory engineering, to include Introductory Engineering 1 and Engineering Science 2. Many students opt to include biology in their electives, reflecting the increasing importance of biomedical engineering applications in Mechanical Engineering.

2. A total of six courses in humanities, arts and social sciences (HASS), including English 1 or 3. Acceptable HASS electives are listed in SIS as SoE-HASS-Humanities, SoE-HASS-Arts, or SoE-HASS-Social Sciences. Courses selected must include a minimum of one credit in each area of Humanities (H) and Social Sciences (SS). In addition, at least two HASS course credits must be taken in the same department.

3. Eight department foundation courses: five required courses related to engineering science, one elective course in probability, statistics, or numerical methods, and two foundation electives that are either natural sciences, mathematics, engineering, or Engineering Management. Note that Engineering Science 101, Mechanical Engineering 108, and Mechanical Engineering 150 can be counted either as a mathematics/science elective or as B.S.M.E. concentration electives, while Engineering Science 55 (Numerical Methods for Engineers) and Engineering Science 56 (Probability and Statistics) can only count as mathematics/natural science foundation electives.

4. Twelve department concentration courses: four required mechanical engineering science courses (Mechanical Engineering 16, 25, 37, and 80), introduction to research instrumentation (Mechanical Engineering 18), two mechanical engineering design courses (Mechanical Engineering 1 and 42), a senior design project elective (Mechanical Engineering 43), and four mechanical engineering concentration electives. Refer to the ME degree sheet for details on department concentration courses.

5. Two free elective courses without restriction.

**Bachelor of Science—Engineering Psychology**  
This program is available for students planning a career or further graduate study in the field of human factors and ergonomics. Students generally should plan to elect the program at the end of the first year and will graduate with a B.S. degree in Engineering Psychology. Program requirements are detailed in this bulletin under Engineering Psychology.  
Students may also pursue an M.S. degree in Human Factors.
CERTIFICATE PROGRAM IN MANUFACTURING ENGINEERING
FACULTY ADVISOR:  
Professor Anil Saigal, Mechanical Engineering

This certificate is offered on a part-time, non-degree basis for post baccalaureate students seeking professional training in manufacturing engineering with emphasis on manufacturing processes, robotics, designs, quality control, or cost-effective production systems. Courses taken in the certificate program may be transferred to the degree program. Professor Anil Saigal is the faculty advisor of this program. The certificate requires four courses.

Two core courses are required:  
**Mechanical Engineering 125** Manufacturing Processes and Materials Technology  
**Mechanical Engineering 180** Digital Control of Dynamic Systems

Two elective courses are required from the following:  
**Mechanical Engineering 108** Modern Quality Control  
**Mechanical Engineering 126** Computer-Integrated Engineering  
**Mechanical Engineering 129** Finite Element Methods in Engineering Systems  
**Mechanical Engineering 182** Automation  
**Mechanical Engineering 184** Robotics  
**Civil and Environmental Engineering 188** Engineering Design with CAD

Further information can be found under Manufacturing Engineering Certificate Program in this bulletin.

CERTIFICATE PROGRAM IN HUMAN-COMPUTER INTERACTION
FACULTY ADVISOR:  
Professor of the Practice Daniel Hannon, Mechanical Engineering

This certificate is offered on a part-time, non-degree basis for post baccalaureate students and is especially useful for computer programmers, Web designers, software engineers, human factors professionals, user interface designers, and others who wish to develop or enhance their user interface design and implementation skills. Courses taken in the certificate program may be transferred to the degree program. Professor Daniel Hannon is the faculty advisor of this program. The certificate requires four courses.

Two foundation courses are required:  
**Computer Science 171** Human-Computer Interaction  
**Psychology 53/Engineering Psychology 61** Engineering Psychology

One additional course from the following:  
**Computer Science 86** Object Oriented Programming for GUIs  
**Engineering Psychology 161** Human Factors in Product Design  
**Engineering Psychology 162** Man-Machine System Design  
**Engineering Psychology 166** Applied Design Software User Interfaces  
**Psychology 130** Advanced Engineering Psychology

Electives:  
**Computer Science 20** Web Programming  
**Computer Science 175** Computer Graphics  
**Electrical Engineering 120** Computer Animation for Technical Communications  
**Occupational Therapy 105** Assistive Technology  
**Engineering Psychology 215** Interface Design in Complex Systems
For more detailed information, please visit the Mechanical Engineering website:
http://engineering.tufts.edu/me/undergraduate/

More detailed information can be found under Human-Computer Interaction in this bulletin.

GRADUATE PROGRAM

Master of Science in Mechanical Engineering

The goal of the Master of Science (M.S.) degree program is to provide students with an opportunity to strengthen their technical backgrounds for pursuing successful professional careers in engineering research, development, and management. Applicants are admitted to this program on the basis of their educational qualifications. A key admission requirement is a strong academic background in mechanical engineering or a related technical discipline. The department also requires all applicants to submit their recent Graduate Record Examination (GRE) scores. More detailed descriptions of all application requirements are provided on the Mechanical Engineering Department website and the Office of Graduate Admissions website.

Two M.S. degrees are offered by the department: a thesis-based M.S. and a non-thesis based M.S. The thesis-based degree typically requires 3 or 4 semesters (1.5-2 years) to complete. The non-thesis based degree may be completed in 2 semesters (1 academic year) of full time study. Both programs require successful completion of ten (10) graduate-level (100-level or above) course credits.

Students in both degree programs are required to choose two core areas from the four available in the department. Students must take a two-course sequence in the two selected core areas in the first two semesters of their M.S. program. The two-course sequence is referred to as core A and core B. The four core area course sequences are Thermal Fluid Systems (ME 111 and ME 112), Material Mechanics and Processing (ME 122 and 125), Robotic, Aeronautic, and Automated Systems (ME 180 and 181), and Design (ME102 and ME149).

Students are also required to take an advanced mathematics course (ME 150, ME108, or ES 101) in semester 2 or 3.

Students in the non-thesis M.S. program will select the remaining five (5) courses as follows. One (1) class in technical communications (either EM252 or ME118), two (2) class credits selected from six professional development courses offered by the Tufts Gordon Institute (EM211, EM231, EM241, EM262, EM254, EM261), and two (2) elective credits selected in consultation with the academic advisor at the graduate level (100-level or above) in any of the engineering disciplines, physical sciences, mathematics, or computer science. One of the two professional development classes can be replaced with an advanced engineering project (ME299) if agreed upon by the student and their academic advisor.

Students in the thesis-based M.S. program must complete a thesis. Ordinarily, the thesis is three of the five remaining required course credits. The exact number of course credits to be considered for the thesis research (two or three) is determined by the thesis committee at the time of the thesis prospectus submission. After selecting a thesis topic and advisor, a student must register for thesis credit and submit a thesis prospectus signed by the student and advisor describing the proposed research. The thesis prospectus must be submitted by the end of the first semester of thesis credit registration. The thesis defense is the final step in obtaining approval for the thesis. The remaining two or three required course credits will be elective credits selected in consultation with the academic advisor at the graduate level (100-level or above) in any of the engineering disciplines, physical sciences, mathematics, or computer science. Full time thesis-based M.S. students must also attend the weekly graduate seminar every semester. At least 80% attendance is required.

Master of Science in Human Factors

Human Factors Engineering is also referred to as Engineering Psychology or Ergonomics. The field is rapidly growing with wide engineering and non-engineering applications. The program offers specialized courses, training and research opportunities in the human-centered aspects of engineering activities such as medical devices and systems design, transportation systems research, product design, computer-interface design, ergonomics and workplace safety.

Although this program has its own entrance and course requirements separate from Mechanical Engineering, it is expected that applicants to the Human Factors program will have an acceptable B.S. in
engineering or science. Relevant course work and research experience may be considered for non-engineering students. It is strongly recommended that the prospective student identify and contact the potential thesis advisor before applying to the program.

Two M.S. (HF) degrees are offered by the department: a thesis-based M.S. and a non-thesis based M.S. The thesis-based degree typically requires 3 or 4 semesters (1.5-2 years) to complete. The non-thesis based degree may be completed in 2 semesters (1 academic year) of full time study. Both programs require successful completion of ten (10) graduate-level (100-level or above) course credits.

Students in both degree programs are required to complete a two-course sequence in each of the following two core areas: Human-Machine Systems and Advanced Probability and Statistics. The courses must be taken in the first two semesters of the M.S. program. The two-course sequence is referred to as core A and core B, with core A being a prerequisite for core B. The two core area course sequences are Human-Machine Systems (ENP 162 and ENP 163) and Advanced Probability and Statistics (PSY 107 and 108).

Students in both programs are also required to take an advanced design course (ME 102 or ENP 161) in semester 2.

Students in the non-thesis M.S. (HF) program will select the remaining five (5) courses as follows. One (1) class in technical communications (either EM252 or ME118), two (2) class credits selected from six professional development courses offered by the Tufts Gordon Institute (EM211, EM231, EM241, EM262, EM254, EM261), and two(2) elective credits selected in consultation with the academic advisor at the graduate level (100-level or above). One of the two professional development classes can be replaced with an advanced engineering project (ME299) if agreed upon by the student and their academic advisor.

Students in the thesis based M.S. (HF) program must complete a thesis. Ordinarily, the thesis is three of the five remaining required course credits. The exact number of course credits to be considered for the thesis research (two or three) is determined by the thesis committee at the time of the thesis proposal defense. After selecting a thesis topic and advisor, a student must register for thesis credit and submit a thesis proposal signed by the student and advisor describing the proposed research. The thesis proposal defense must be completed by the end of the first semester of thesis credit registration. The thesis defense is the final step in obtaining approval for the thesis. The remaining two or three required course credits will be elective credits selected in consultation with the academic advisor at the graduate level (100-level or above). Full time thesis-based M.S. students must also attend the weekly graduate seminar every semester. At least 80% attendance is required. Finally, M.S. (HF) candidates are also expected to present their research at scientific conferences (e.g., ASME, HFES, IEA, IEEE SMC) and submit at least one paper to a peer-reviewed scientific journal.

Doctor of Philosophy

Applicants to the Ph.D. program are expected to have an outstanding academic record in mechanical engineering or a related discipline. All applicants to the Ph.D. program should outline in writing their reasons for applying to the doctoral program, and their tentative plan of study. For general information and admission requirements for the Ph.D. degree, see the graduate school section of this bulletin.

For admission to doctoral candidacy, the individual must pass a qualifying examination by the end of their fourth academic semester if entering the program with an M.S., or by the end of their sixth academic semester if entering the program with a B.S. The student must select four out of the eight exam areas (Physical Ergonomics, Cognitive Human Factors, Dynamics, Controls, Fluid Dynamics, Heat Transfer, Solid Mechanics, and Materials Processing) for the written qualifying examination, and pass an oral examination.

A Ph.D. candidate is required to complete at least five course credits beyond the M.S. degree in classroom courses at the 100 level or higher. Doctoral candidates are expected to pursue either course work in direct support of their research or course work that addresses the recommendations made during the qualification period. In the interest of broadening the educational experience, students are also expected to take at least one advanced course 200 level or higher, either within or outside of the department.

After the successful qualifying exam, Ph.D. candidates are required to present a thesis prospectus to a committee composed of the thesis advisor, other mechanical engineering faculty, and possibly outside experts. This presentation includes questioning by the committee and other faculty to assess whether the candidate has sufficient background to study the research area. The purpose of the prospectus is to inform the department in a concise statement of the candidate’s research program.
Ph.D. candidates must defend their dissertation in an oral examination, open to the community. The candidate is examined by a committee of at least three members, one of whom is an expert from outside the mechanical engineering department, and another from outside Tufts University.

For more detailed information, please visit the Mechanical Engineering website: 
http://engineering.tufts.edu/me/graduate/phd.htm.
The interdisciplinary minor in medieval studies presents a multidisciplinary focus on the world of the Middle Ages. The medieval world introduces us to the cultural roots of Europe and Islam in a preindustrial society and to the beginnings of Western and Middle Eastern languages and literatures.

Five credits with at least one course from each of the three categories (as stated online) are required for the minor. In addition to the five credits, a student is required to complete an appropriate project, such as a thesis, an oral presentation, or a performance, which integrates the knowledge and methodologies of the disciplines involved. (See Interdisciplinary Minor Program for details.)
In today’s changing economy, the microwave and wireless engineering industry is moving away from developing traditional military applications and toward exploration of commercial opportunities. With the new availability of relatively inexpensive microwave components and improved digital communications, these opportunities have few limits. Radar, satellite, wireless radio and optical communications, cellular phone, cruise control and collision avoidance radar are just a few areas which utilize microwave technology.

In addition, computer hardware researchers and designers are finding that microwave engineering concepts are necessary to develop gigahertz and faster computer circuits. As engineers explore low microwave frequencies and even lower radio frequencies, this technology is now applied to cable, broadband, television, medical, and other commercial uses.

In collaboration, the Department of Electrical and Computer Engineering offers a five-course, graduate-level certificate in microwave and wireless engineering. The certificate program educates professionals in the exciting new uses of microwave and wireless technology through extensive laboratory and project work. The program can be pursued on a part-time, non-degree basis by professionals seeking advanced development and training or as an intermediate step to a master’s degree. In most cases, courses taken as part of a certificate program can be transferred into a graduate-degree program in electrical engineering. The program is open to students with a bachelor’s degree in electrical engineering or physics or with equivalent preparation, including a background in general physics and intermediate circuit theory.

The certificate requires five courses.

Two required courses:
EE 117 Introduction to Microwave Devices
EE 118 Microwave Semiconductor Devices and Circuits

Three graduate-level elective courses in microwave engineering or related fields:
EE119 Microwave System Engineering
EE 136 Antennas for Radar, Avionics, and Communications
EE 137 Radar Engineering
EE 148 Silicon Radio Frequency IC Design
EE 160 Computer-Aided Design of Microwave Circuits
EE 161 Microwave Integrated Circuits

(Students may substitute other Tufts graduate courses, subject to the approval of the certificate faculty advisor.)

For more information, contact the program administrator, Angela Foss, angela.foss@tufts.edu, 617-627-2320, or the faculty advisor, Mohammed Nurul Afsar, mafsar@ece.tufts.edu, 617-627-3217, or visit http://engineering.tufts.edu/ece/graduate/certificate.htm.
Middle Eastern Studies

DIRECTOR:
Hugh Roberts, Edward Keller Professor of North African and Middle Eastern History

FACULTY:
Professor Ina Baghdiantz-McCabe, History
Professor Leila Fawaz, History
Professor Bruce Hitchner, Classics
Professor Ayesha Jalal, History
Professor Beatrice Manz, History
Professor Malik Mufti, Political Science
Professor Enrico Spolaore, Economics
Associate Professor Gloria Ascher, Judaic Studies
Associate Professor Steven Hirsch, Classics
Associate Professor Richard Jankowsky, Music
Associate Professor Christina Maranci, Art and Art History
Associate Professor Hugh Roberts, History
Associate Professor Joel Rosenberg, Judaic Studies
Assistant Professor Amahl Bishara, Anthropology
Assistant Professor Elizabeth Foster, History
Assistant Professor Kenneth Garden, Religion
Assistant Professor Eva Hoffman, Art and Art History
Assistant Professor Nimah Mazaheri, Political Science
Assistant Professor Kamran Rastegar, Arabic Language and Literature
Lecturer Rana E. Abdul-Aziz, Arabic Language and Literature
Lecturer Thomas Abowd, Anthropology
Lecturer Rabab El Nady, Arabic Language
Lecturer Hedda Harari-Spenser, Hebrew Language and Literature
Lecturer Fadi Jajji, Arabic Language
Lecturer Haci Osman Gunduz, Arabic Language
Lecturer SouhadZendah, Arabic Language

Middle Eastern Studies is an interdisciplinary program that encourages breadth and significant immersion in one or more Middle Eastern cultures. The program gives students an opportunity to study the history and culture of the Middle East and of areas of the world whose territories were part of Middle Eastern empires or were under the influence of Middle Eastern civilizations in pre-modern and modern times. Study abroad is highly recommended.

UNDERGRADUATE CONCENTRATION REQUIREMENTS

Major in Middle Eastern Studies
The Middle Eastern Studies major has recently been modified in respect of the course requirements, with particular reference to the language requirement, which has been relaxed. Students who matriculate in fall 2014 will have to conform to the new revised requirements.

Revised Requirements of the Major
The Middle Eastern Studies major comprises twelve courses:

i. Four courses of a Middle Eastern language (level 3–4 or equivalent). Students who have demonstrated language competence through level 3–4 by a placement test must take two advanced language courses and either two semesters of a second Middle Eastern language or two other courses from the list referred to in section ii.

ii. Six courses in Middle Eastern studies—chosen in consultation with an advisor—from an approved list updated by the Middle Eastern Studies program annually. Three courses must be chosen from each of the following two groups:
   A. art history, religion, literature, Judaic studies, music, and
   B. anthropology, history, political science.
These courses must include at least one course in pre-modern and one course in modern Middle Eastern studies. They must also include one course in each of two Middle Eastern cultures. Two of these courses may be more advanced language courses (21–22 and beyond).

iii. One course that relates the Middle East to other regions of the world.
iv. One advanced research course, such as thesis honors, a seminar, or advanced directed study.

For more detailed information, please contact Professor Roberts at hugh.roberts@tufts.edu.
Multimedia Arts

CO-DIRECTORS:
Professor Karen Panetta, Electrical and Computer Engineering
Howard Woolf, Experimental College

CORE FACULTY:
Professor Karen Panetta, Electrical and Computer Engineering
Associate Professor Alva Couch, Computer Science
Assistant Professor Eva Hoffman, Art and Art History
Associate Director Howard Woolf, Experimental College
Senior Lecturer Neal Hirsig, Drama and Dance
Lecturer Paul Lehrman, Music

OUR MISSION
The Multimedia Arts (MMA) program actively seeks to break down the old divide between the arts and technology. We believe that students in engineering and the sciences who are exposed to the arts and humanities expand their horizons and that students across the liberal arts deeply enrich their education by becoming technologically literate.

OUR PARTNERS
Linking the School of Engineering with the School of Arts and Sciences, the MMA program is supported by the Electrical and Computer Engineering Department and the Computer Science Department in concert with the Experimental College, Art and Art History Department, Drama and Dance Department, and Music Department.

INTERDISCIPLINARY MINOR IN MULTIMEDIA ARTS
The multimedia arts program provides a framework for the analysis of and practical training in emerging digital media. The minor includes—and often mixes—work in animation, filmmaking, photography, music, text, drawing, collage, graphic design, software development, website construction, user interface strategies, and human factors theory. Through course work and collaboration on the part of students in liberal arts and students in technical disciplines, the minor aims to foster the development of a body of shared knowledge and ideas and, in so doing, to break down barriers that have traditionally hindered such cross-fertilization.

Requirements for the Minor
The specific requirements for the MMA minor incorporate four elements: work in multimedia practice, taking an appropriate set of electives, enrolling in the FMS Senior Colloquium, and completing a Senior Project.

Multimedia Practice. Each student enrolled in the minor must take at least two full-credit, letter-graded courses from an approved list of classes that introduce students to the tools, methods, and theories current in the field.

Electives. In addition, each student must take three full-credit, letter-graded courses selected from classes offered by the supporting departments (Electrical Engineering, Computer Science, Art and Art History, Drama and Dance, and Music) or from appropriate classes across the curriculum.

Senior Colloquium (half-credit, pass/fail). This is a mandatory course for students enrolled in any of the three FMS minors who are doing Senior Projects. It is to be taken in the fall of a student’s senior year and is designed to aid in the planning and successful completion of your Senior Project.

Senior Project (full-credit, letter-graded). The Senior Project is an original work that reflects an understanding of and facility with one or more of the expressive and/or conceptual disciplines associated with multimedia. Collaborative projects are strongly encouraged.

Notes Regarding the Minor
Courses taken for major credit cannot be counted as MMA electives.
Only one course in a field related to your major may count as an MMA elective. For example, if a Music major takes one course in Art and Art History, then all other electives must fall outside the arts. Conversely, if a Computer Science major takes one course in Electrical and Computer Engineering, then all other electives must fall outside engineering.

Where appropriate, a third multimedia practice course may count as an elective.

All elective choices must be made in consultation with your MMA adviser.

For more information about the policies governing requirements and electives, visit http://ase.tufts.edu/cms/mma.html.
As the stature and number of museums grow, so has the need for appropriate professional training. More than ever before, today’s museum professionals need to be problem-solvers, educators, administrators, and logistical experts who understand not only the information that their collections hold, but how to tell their stories. Offered in collaboration with the Tufts Departments of Art and Art History, Classics, Education, and History, and the Office of the Dean of the Graduate School of Arts and Sciences, the program equips students with the theories and practices needed for the 21st-century museum.

Students may pursue the certificate program, consisting of four courses and an internship, or a master’s degree program in art history, history, or education. Together, certificate and masters students take museum studies courses that cover museum history, administration, education, collections management, preservation, material culture, fund-raising, evaluation, new media, and exhibition planning. The internship enables students to apply what they have learned in the classroom and to expand their networks.

The program is open to individuals with a bachelor’s degree interested in pursuing a museum-based career, museum professionals who wish to improve their credentials for career advancement, and professionals in other fields who wish to shift career direction.

For more information, contact the program administrator, Angela Foss, at 617-627-2320 or visit the website http://museumstudies.tufts.edu.
Music

Professor Joseph Auner, Dean of Academic Affairs; music history, musicology, music and technology, sound studies
Professor Jane A. Bernstein, Emerita; music history, musicology
Professor David Locke, Chair, ethnomusicology, music culture, performance
Professor John McDonald, Composition, music theory, performance, orchestration (on leave 2016–17)
Research Professor/Rabbi Jeffrey Summit, Ethnomusicology, music in the Jewish tradition, social justice and advocacy
Associate Professor Alessandra Campana, Director of Undergraduate Studies; music history and aesthetics, opera studies, audiovisual media
Associate Professor Richard Jankowsky, Ethnomusicology, music culture, music and ritual (on leave Spring 2017)
Associate Professor Stephan Pennington, Director of Graduate Studies; music history, musicology, cultural theory
Assistant Professor Melinda Latour, Music history, musicology
Assistant Professor Frank Lehman, Music theory, music and film
Lecturer Jamie Kirsch, Director of Choral Activities; music theory
Lecturer Paul Lehman, Director of Music Engineering; Electronic Music Ensemble; music technology
Lecturer John Page, Director of Orchestral Activities; music theory
Lecturer Joel Larue Smith, Director of Jazz Activities: jazz composition, theory, and performance
Lecturer Michael Ullman, History of Blues and Jazz
Paul Ahlstrand, Small Jazz Ensemble
Nina Barwell, Flute Ensemble
Donald Berman, New Music Ensemble
David Coleman, Gospel Choir
Polina Dessiatnitchenko, Ethnomusicology (2016–17)
Barry Drummond, Javanese Music Ensemble
Jane Hershey, Early Music Ensemble
Eun Young Lee, Composition, Tufts Composers (2016–17)
Carol Mastrodomenico, Opera Ensemble
John McCann, Wind Ensemble; music theory, musicianship
Michael McLaughlin, Klezmer Ensemble; music theory, musicianship, performance
Fernando Michelin, Small Jazz Ensemble; piano performance
Attah Emmanuel Poku, Kiniwe African Music and Dance Ensemble
Kareem Roustom, Composition for multimedia, orchestration
Jacob Sagrans, Musicology (Fall 2016)
Lyath Sidiq, Arab Music Ensemble

Music plays an essential role in a liberal arts college education. Musical studies integrate mind, body, and spirit. Students who study music in college prepare themselves for a lifelong appreciation of the musical arts. The faculty of the Music Department guide students along a rigorous yet joyful pursuit of knowledge in the following fields: instrumental/ensemble performance, theory of music, history of music, social/cultural musical context, music composition, and the science and technology of music. Music studies are interdisciplinary, drawing on other disciplines in the arts, humanities, social sciences, mathematics, sciences, and engineering. Studies in music teach transferable skills of value for careers in the professions and business.

The Music Department offers courses in the disciplines of composition, ethnomusicology, music theory, musicology, and performance. Our curriculum is inclusive and diverse, with emphasis on the traditions of Western art music, American music (especially African American music and jazz), and world music (especially African and Middle Eastern music). Individual study of instrumental and vocal performance and participation in performing ensembles is enthusiastically endorsed; students may earn academic credit for these musical activities.

The Music Department’s flexible program serves (a) those students who would choose music as a major or minor, and (b) all students seeking to develop their musical knowledge and/or performance skills. Students may major in music, double major in music and another field, or minor in music. Music courses fulfill many requirements (arts distribution, world civilizations, international relations, American studies, and several interdisciplinary minors). The courses, programs, and facilities of the Music Department are open to all members of the Tufts community.

PERFORMANCE OPPORTUNITIES

The Music Department provides students the opportunity for private study of instrumental and vocal performance with the outstanding faculty in our performance program. Lessons may be taken for half credit (0.5) or not for credit (NC). A fee of $700 (2016–2017) is required; beginning in the junior year, students majoring or minoring in music are eligible for a ninety-percent tuition waiver for two semesters. Majors and minors must apply for the major/minor scholarship, and must study for two semesters at the 153-01 and 02 levels in order to receive the tuition waiver. For detailed information, contact Edith Auner, Coordinator of Performance, (edith.auner@tufts.edu; 617-627-5616).

Faculty in the Music Department teach a diverse variety of courses in ensemble performance, including African Music and Dance Ensemble (Kiniwe), Arab Music Ensemble, Chamber Music Ensembles, Chamber Singers, Chamber Orchestra, Concert Choir, Early Music Ensemble, Electronic Music Ensemble, Flute Ensemble, Gospel Choir, Javanese Gamelan Ensemble, Jazz Improvisation Ensembles, Jazz Orchestra, Klezmer Ensemble, New Music Ensemble, Opera Ensemble, Pep Band, Symphony Orchestra, and Wind Ensemble. Enrollment in performing groups requires audition; contact the Music Department Office for audition information (musicadmin@tufts.edu; 617-627-3564). Musical excellence is highly valued, but membership is more inclusive than in music conservatories.
Eleven courses (ten credits) are required for the undergraduate major in music:

a. History of Western Music (two 1.0 credit courses): MUS 142 & 143.
b. Principles of Tonal Theory I and II (two 1.0 credit courses): MUS 101 & 102.
c. Advanced Theory (one 1.0 credit course): one course from the MUS 103–110 range.
d. Ethnomusicology: World, Ethnic, Folk, and Traditional (two 1.0 credit courses): MUS 186, and one course from the MUS 106–110, 171–185, or 187–196 ranges.
e. Western Popular Music, Jazz, Global Musics, or Cultural Theory (one 1.0 credit course): one course from the MUS 187–196 range.
f. Performance: Instrumental/Vocal Study (two 0.5 credit courses): MUS 153 (01 and/or 02).
g. Electives: Theory, Composition, Ethnomusicology, Musicology, Performance (two 1.0 credit courses): two courses chosen from the MUS 111–141 and/or 145–199 ranges.

Note: the prerequisite for all 100-level courses is MUS 10, or exemption from that course through the Music Theory Placement Test given at the start of each semester, or permission of the instructor. For information about the Music Theory Placement Test please contact the Music Department Office (musicadmin@tufts.edu; 617-627-3564).

In addition to the courses listed above, students who would major in music must enroll in a performing ensemble course (MUS 69–96) for four semesters. Ensembles may be taken for credit or non-credit; however, credit for ensembles does not count toward the eleven courses required for the major. Courses taken to fulfill the foundation, distribution, concentration, or minor requirements may not be taken pass-fail.

UNDERGRADUATE MINOR PROGRAMS

Minor in Music
Students who intend to make music studies a significant part of their course work at Tufts may choose the disciplinary minor in music. Students may take a broad range of courses or may choose a cluster of courses in a focused area of musical study. The undergraduate minor in music requires a minimum of six courses (five credits). At least two courses must be at the 100 level; the other courses may be chosen from 100-level courses or from the MUS 21–67 range. Two semesters in instrumental and/or vocal study (MUS 153-01 and/or 02, or MUS 195) are required, but no more than 1.0 credit of private lessons may count towards the minor. Furthermore, students minoring in music must enroll in a performing ensemble course (MUS 69–96) for two semesters, but these credits cannot count toward the minor. After consultation with a member of the full-time music faculty for advice on a suggested program of study, students should complete the minor declaration form available from the Music Department Office (musicadmin@tufts.edu; 617-627-3564).

Minor in Music Engineering
This interdisciplinary minor is offered through the School of Engineering, but is open to all undergraduates. It is a joint effort of the Music, Computer Science, Mechanical Engineering, and Electrical Engineering departments. For specific information about fulfilling the minor requirements, visit http://go.tufts.edu/musicengineering.

Minor in Multimedia Arts
This interdisciplinary minor is offered through the Communications and Media Studies program. For specific information about the policies governing requirements and electives, visit http://ase.tufts.edu/cms/mma.html.

COURSES AT NEW ENGLAND CONSERVATORY OF MUSIC

A reciprocal arrangement between Tufts University and New England Conservatory of Music allows students at both institutions to select a limited number of courses at either school that may be applied toward their respective degrees. Students may not take a course at the conservatory if it is offered at Tufts. This agreement does not apply to summer school. Students must first receive permission from their primary dean and then from the dean of the second institution.

GRADUATE PROGRAM

Master of Arts
The Music Department offers the degree of Master of Arts in the scholarly disciplines of composition, ethnomusicology, music theory, and musicology. Applicants for the master’s degree must demonstrate a distinctive background in music studies, must submit a writing sample or composition portfolio as part of their application, and are required to take the Graduate Record Examination (GRE). The two-year program of study consists of ten semester courses numbered 100 and above (excluding MUS 101–102, 142–143, 153, 186 and 195), including a capstone project that includes a substantial written component. The capstone project may take the form of a master’s thesis,
composition, exhibit, lecture-recital, or other rigorous academic work determined in consultation with the student’s advisor. A reading proficiency in one foreign language is required. Students are expected to take music courses both inside and outside their discipline of concentration. The department encourages students to gain practical experience in performance courses and up to one credit from performance ensemble courses may be applied toward the Master of Arts degree.

For more detailed information, please visit the website http://as.tufts.edu/music.
Music Engineering

Administrator:
Lecturer Paul Lehrman, *Music*

Advisor:
Professor Chris Rogers, *Mechanical engineering*

UNDERGRADUATE MINOR

The minor in Music Engineering provides students with experiences at the intersection of music and technology. Students learn the technologies behind music-making, both traditional and modern, and how new technologies can be applied to musical goals. The minor is available to students both in the School of Engineering and the School of Arts and Sciences. The minor replaces the minor in Musical Instrument Engineering.

The minor consists of five courses and a final project (six units in total). The minor has three possible emphases: (1) sound recording and production, (2) electronic instrument design, and (3) acoustic instrument design. Students can follow any one of these emphases, which will influence the choice of final project.

Course requirements for the minor include:

1. One music course from Music 10 (Introduction to Music Theory and Musicianship), 101/102/103 (Principles of Tonal Theory I/II/III), 104 (Jazz Theory), or 118 (Composition Seminar).
2. A two-course concentration in one of:
   a. Sound recording and production:
      - Science and Engineering of Music, which can be taken as a Music, Physics, or Mechanical Engineering course, or Physics 10 (Physics of Music and Color, no longer offered).
      - Electrical Engineering 65 (Music Recording and Production).
   b. Electronic instrument design:
      - EE 12 (Analog Electronics) or EE 125 (Digital Signal Processing).
   c. Acoustic instrument design:
      - Mechanical Engineering 139 (Acoustics) or 181 (Advanced Dynamics and Vibrations).
      - Engineering Science 73 (Musical Instrument Design and Manufacture) or an approved course in Musical Instrument Making from the School of the Museum of Fine Arts.
3. Music 64 (Computer Tools for Musicians), Electrical Engineering 65 (Music Recording and Production), Music 65 (Music Recording and Production), Music 85 (Electronic Music Ensemble), or Computer Science 150-ISW (Music Apps on the iPad).
4. One credit from the following options: Music 64, Music 65, Electrical Engineering 65, Engineering Science 73 (Musical Instrument Design and Manufacture), Engineering Science 95/Music 66, Music 85 (Electronic Music Ensemble, 0.5 credit), or an Engineering Internship (EE 99 or ME 99) or Independent Study course (EE 93 or 94, ME 93, or Music 97) on an approved topic supervised by a participating minor advisor, or a course on acoustic instrument design, sound, sculpture, or performance from the School of the Museum of Fine Arts.
5. A one-credit final project (EE 95 or 96, or both EE 97 and 98; ME 43 or 94; or Music 98) on an approved topic, supervised by a participating minor advisor.

Each student taking the minor must have a minor faculty advisor who approves course selections and mentors the final project. Each minor must include at least two courses with Engineering course designations. A list of approved courses available at the School of the Museum of Fine Arts is available from the program directors. For more information, visit [http://go.tufts.edu/musicengineering](http://go.tufts.edu/musicengineering).
Nutrition

The Gerald J. and Dorothy R. Friedman School of Nutrition Science and Policy at Tufts University was established in 1981, bringing together experts from the areas of clinical nutrition, social and public policy, and biomedicine. Faculty at the school focus on a variety of issues across disciplines with the common thread of nutrition and its role in fostering the growth and development of human populations.

The school offers Master of Science and Doctor of Philosophy degrees, and in cooperation with the Frances Stern Nutrition Center of the Tufts Medical Center, a combined Master of Science with Dietetic Internship program. Dual-degree programs are offered with the School of Medicine (M.S./M.P.H.), with The Fletcher School of Law and Diplomacy (M.S./M.A.L.D.), with the Graduate School of Arts and Sciences Department of Urban and Environmental Planning (M.S./M.A.), and with Boston College’s Carroll School of Management (M.S./M.B.A). In addition, a one-year Master of Arts in Humanitarian Assistance (M.A.H.A.) is offered in conjunction with The Fletcher School.

Friedman has expanded its reach online with both degree and non-degree programs. The Master of Nutrition Science and Policy degree program (M.N.S.P.) is offered through a blend of online learning with short residencies on the Health Sciences campus located in downtown Boston. The Friedman School has also created 5 Online Graduate Certificate Programs: Nutrition Science for Health Professionals, Nutrition Science for Communications Professionals, Developing Healthy Communities: Nutrition, Behavior, and Physical Activity, Delivery Science for International Nutrition, Sustainable Agriculture and Food Systems.

The school’s faculty lead a wide variety of educational, research and engagement programs in Boston and elsewhere. The faculty includes agronomists, biomedical scientists, economists, geographers, physicians, veterinarians, psychologists and others, all dedicated to teaching and research to improve the nutritional well-being of people worldwide. Some faculty members have their primary appointment and maintain laboratories at the Jean Mayer USDA Human Nutrition Research Center on Aging (HNRCA). Shared appointments can also be found with the School of Medicine, Sackler School of Graduate Biomedical Sciences, and Tufts Medical Center.

The Friedman School is located at 150 Harrison Avenue, Boston, Massachusetts 02111; phone 617-636-3777, fax 617-636-3600. For more information about the school, its degree programs and its research, visit the website www.nutrition.tufts.edu.

For current course listings, visit www.nutrition.tufts.edu. Although no undergraduate degree programs are offered, a variety of courses are available to undergraduates. Consent must be obtained from the instructor for courses numbered 200 and above.
Occupational Therapy

**Professor Sharan L. Schwartzberg**, *Interim Chair*, Group theory and practice, psychosocial rehabilitation, interprofessional healthcare teams

**Professor Linda Tickle-Degnen**, Healthy and active aging, nonverbal and verbal behavior in health quality of life, clinical reasoning, evidence-based practice, research methods

**Associate Professor Gary Bedell**, Outcomes measurement, research methods, clinical reasoning, social participation of children and youth

**Assistant Professor Keren Ladin**, Health policy, research methods, public health ethics, health disparities, medical ethics.

**Assistant Professor Elizabeth (Beth) Marfeo**, Work disability, productive-aging, health services research, measurement development.

**Senior Lecturer Janet Curran Brooks**, Occupational therapy practice in physical medicine, hand and upper extremity rehabilitation

**Lecturer Jessica Harney**, Clinical reasoning, kinesiology, health and community systems; health conditions management

**Lecturer/Academic Fieldwork Coordinator Susan M. Higgins**, Group and psychosocial practice; cognitive disabilities model, occupational therapy fieldwork, animal-assisted therapy

**Lecturer Margaret Morris**, Pediatrics, clinical practice, school-based service

**Fieldwork Coordinator, Mary Barnes**, Group leadership and community-based practice, occupational therapy fieldwork

**Part-time and affiliated faculty:**

**Lecturer Jennifer Buxton**, Assistive technology

**Lecturer Megan Gately**, Older adults, clinical reasoning, advanced dementia

**Lecturer Paul C. Leavis**, Physiology

**Lecturer Jean Lyons Martens**, Adult and pediatrics

**Lecturer Teresa May-Benson**, Sensory integration and praxis, autism and developmental disabilities, test development, research methods and evidence-based practice

**Lecturer Monica Pessina**, Anatomy and neuroanatomy

**Lecturer Stephen N. Sarikas**, Anatomy

**Lecturer Sarah Everhart Skeels**, Health promotion/disease prevention and disability

**Lecturer Elizabeth Ratcliff Whitney**, Anatomy and neuroanatomy

**Affiliated Faculty Scott Trudeau**, Occupational therapy practice in psychiatry, gerontology

The Department of Occupational Therapy, originally the Boston School of Occupational Therapy ("BSOT" for short), was founded in 1918 at the request of the surgeon general of the United States Army. In 1945, BSOT became affiliated with Tufts University. The Department is part of Tufts Graduate School of Arts and Sciences and is situated on the Medford/Somerville campus in the Collaborative Learning and Innovation Complex at 574 Boston Avenue.

Department of Occupational Therapy has an impressive array of resources for learning, practice, and research. We ensure the broadest and most relevant education, fostering clinical reasoning skills needed for collaborating with diverse client, community, and professional groups to address complex, rapidly changing healthcare and societal needs. As part of the Tufts Graduate School of Arts and Sciences, the department is ideally positioned to educate future professionals, researchers and leaders who can actively participate in and advance an interdisciplinary and inter-professional approach to health and healthcare. Through our education, research, and practice, we promote participation in meaningful activity ("occupation") of individuals, communities and populations with diverse needs and experiences.
GRADUATE PROGRAMS
The department offers both masters and doctoral degree programs which prepare graduates for work as practitioners, administrators, researchers, educators and leaders. The program interfaces the social and the health sciences, recognizing the importance of the profession’s theoretical base in both the liberal arts and the sciences.

Clinical reasoning is a central organizing framework of the curriculum. It provides a foundation for making informed clinical decisions based on observation, interaction, theoretical principles and procedures underlying assessments and interventions and consideration of the best available research evidence. Human behavior and participation in meaningful activities results from dynamic interaction between the individual’s innate potentials and characteristics, and experiences with people, objects, and events in the environment. In ongoing clinical reasoning seminars, the faculty and students examine these interactions in the contexts of clinical and community-based practice.

MASTERS DEGREE PROGRAMS
The masters degree programs prepare students for entry-level positions in occupational therapy and provide post-professional graduate studies for individuals who are already occupational therapists.

Program options are described below.

Entry-Level Program (for Non-OTRs)
(Options I and II)

Eligibility: A bachelor’s degree in a field other than occupational therapy. Candidates enter the program at the professional level and proceed to eventual certification as registered occupational therapists. Program can be completed with 2 ½ years and must be completed on a full-time basis.

Prerequisites: (Total of six courses.) All prerequisites must be passed with a grade of B- or better and taken at an accredited college: one course in social sciences (i.e., anthropology, psychology, sociology); one course in developmental psychology or human development; one course in abnormal psychology; two courses in biology, including content in cell biology (anatomy and physiology may be substituted for the biology prerequisite; one biology course must have a lab component); one course in introductory statistics. Certificate of Hepatitis B vaccination upon enrollment is required.

Option I (No thesis)
Master of Science in Occupational Therapy

REQUIRED COURSES
OTS 101 Human Physiology (one course credit)
OTS 102 Gross Anatomy (one course credit)
OTS 103 Neuroanatomy (one course credit)
OTS 104 Kinesiology (one course credit)
OTS 106 Occupation and Adaptation in the Child and Adolescent (one course credit)
OTS 107 Occupation and Adaptation in the Adult Years (one course credit)
OTS 137 Fieldwork Seminar (no credit)
OTS 138 Fieldwork Seminar (no credit)
OTS 205 Clinical Reasoning Seminar I: Observation and Interpretation (one-half course credit)
OTS 206 Clinical Reasoning Seminar II: Interactive Reasoning in the Practice of Occupational Therapy (one-half course credit)
OTS 207 Clinical Reasoning Seminar III: Procedural Reasoning in the Practice of Occupational Therapy (one-half course credit)
OTS 209 Clinical Research (one course credit)
OTS 219 Group Theory and Community-Based Practice (one course credit)
OTS 224 Occupational Therapy Practice in Physical Dysfunction (one course credit)
OTS 226 Occupational Therapy Practice with Pediatric Population (one course credit)
OTS 227 Occupational Therapy Practice in Psychosocial Dysfunction (one course credit)
OTS 229 Occupational Therapy Practice with Older Adults (one course credit)
OTS 232 Health and Community Systems (one-half course credit)
OTS 233 Occupational Therapy Management and Administration (one-half course credit)
The total number of minimum course credits for the degree is 16. In addition to the 16 required credits, non-thesis students may take two additional graduate level elective credits in the department or wider university.

To maintain full-time status, a student must be registered for a minimum of three course credits. Several course sequences are utilized by the department. Some of these include fieldwork during the summer, part-time fieldwork, and fieldwork during the academic year with course work in the summer. Please consult the department for further information.

Option II (Thesis)
Master of Science

Required Courses: All of the option I requirements, but no electives. The same 16-credit course sequence as Option I.

Thesis: Two course credits of thesis supervision (OTS 295, 296) and completion of thesis.
Total number of credits required for the degree is 18 (16 course credits and two thesis credits).

Post-Professional-Level Programs for OTRs
(Options III and IV)

These programs are for post-professional students interested in developing their knowledge base in areas such as administration and management, aging, assistive technology, education, mental health, school-based practice, and upper extremity rehabilitation. Students may also choose the self-directed concentration focused on their individual interests.

Eligibility: Registered occupational therapists or candidates eligible for registration.

Prerequisite: One course in introductory statistics. The prerequisite course must be passed with a grade of B- or better and taken at an accredited college.

Option III (No thesis—practice option)
Master of Science in Occupational Therapy

Required Courses: OTS 209 (Clinical Research, one course credit); OTS 208 (Clinical Reasoning Seminar IV, one course credit), OTS 288 (Outcomes Measurement & Monitoring, one course credit). These required courses may be taken in any sequence or combination depending on student interest, schedule, and courses offered.

Concentration: Three courses in an area of concentration; one practicum (OTS 234 or OTS 235).

Electives: Three course credits.

Practica: One practicum (OTS 234 or OTS 235, one credit.

Total number of course credits for the degree is ten.

Option IV (Thesis—research option)
Master of Arts or Master of Science

Required Courses: OTS 209 (Clinical Research, one course credit); OTS 208 (Clinical Reasoning Seminar IV, one course credit); OTS 288 (Outcomes Measurement & Monitoring, one course credit).

Thesis: Two course credits of thesis supervision (OTS 295 & 296) and completion of thesis.

Concentration: Three courses in concentration (three course credits).

Electives: Two course credits.
Total number of course credits for the degree is ten.

**DOCTORAL DEGREE PROGRAM (OTD)**
The Occupational Therapy Doctoral degree program at Tufts prepares occupational therapists to fulfill leadership roles. These roles are expected to make a real impact on individuals and groups in society and the world in such areas as health functioning, wellness, and quality of life. As leaders, the graduates will be prepared to implement leadership projects and disseminate results. This program can be completed on a full time or part time basis and requires a total of 8 credits. A master’s degree is required for admission. Required credentials are found at [ase.tufts.edu/bsot](http://ase.tufts.edu/bsot).

**REQUIRED COURSES**
- **OTS 208** Clinical Reasoning Seminar IV: Evidence-Based Practice (one course credit)
- **OTS 286** Leadership Project Planning (one-half course credit)
- **OTS 287** Leadership Project Implementation (one and one-half course credits)
- **OTS 288** Outcomes Measurement and Monitoring: Using Data to Inform Practice (one course credit)
- **OTS 289** Integrative Paper (one course credit)
- **OTS 297 and 298** Proseminar (one-half course credit each)
- Two graduate level courses in specialty area (equivalent to two course credits)

Total number of course credits for the degree is eight.

**CERTIFICATE PROGRAM**
The certificate program is offered on a non-degree, part-time basis to occupational therapists seeking advanced professional education in occupational therapy or preparing to enter a graduate degree program. Upon department approval, these courses can be used for the Occupational Therapy post-professional M.S. degree, if students are interested and accepted into that program.

The certificate program gives students the option of focusing on an area of specialization, such as hand and upper extremity rehabilitation, occupational therapy in the schools, or working with a faculty advisor to design their own program of study. For more information, contact the program administrator, Angela Foss, at 617-627-2320 or visit the website [http://gradstudy.tufts.edu/programs/certificates/index.htm](http://gradstudy.tufts.edu/programs/certificates/index.htm).

**Certificate of Hand and Upper Extremity Rehabilitation**
The hand and upper extremity rehabilitation specialization is intended for practicing occupational therapists who would like to gain knowledge in the specialty area of hand and upper extremity therapy. Tufts Department of Occupational Therapy students who are interested in this content and practice area are also invited to apply. Therapists and students who complete this four-course series are well positioned to apply for positions in outpatient and hand therapy departments.

The certificate requires four course credits as follows:
- **OTS 274** Topics in Hand and Upper Extremity Rehabilitation I: Fall
- **OTS 275** Topics in Hand and Upper Extremity Rehabilitation II: Spring
- **OTS 276** Topics in Hand and Upper Extremity Rehabilitation III: Summer
- One research course (select one):
  - **OTS 208** Clinical Reasoning IV: Evidence-Based Practice
  - **OTS 209** Clinical Research
  - **OTS 288** Outcomes Measurement and Monitoring

**Certificate of School-Based Practice**
This certificate in school-based practice is intended for licensed occupational therapists interested in expanding their knowledge base to become specialized practitioners in the provision of academically relevant occupational therapy services in public schools. Tufts Department of Occupational Therapy students who are interested in this content and practice area are also invited to apply. Therapists who complete this four-course
series will learn how to influence services within their schools consistent with special education law and the American Occupational Therapy Association standards.

This certificate requires the following:
Two core courses:
- OTS 284 School-Based Practice: Programmatic Issues
- OTS 285 School-Based Practice: Assessment to Intervention

One research course (select one):
- OTS 208 Clinical Reasoning IV: Evidence-Based Practice
- OTS 209 Clinical Research
- OTS 288 Outcomes Measurement and Monitoring

One content course in the area of services to children (to be approved by advisor)

Certificate of Advanced Professional Studies
Occupational therapists are confronted with administrative and supervisory responsibilities and the need for increased specialization. Areas of practice such as health and wellness consulting, technology and assistive device development, and community-based health services are emerging practice areas. To help occupational therapists meet these demands, Tufts Department of Occupational Therapy, in conjunction with the Office of Graduate Studies, offers a part-time program, the Certificate of Advanced Professional Study.

The certificate requires four course credits as follows:
- OTS 209 Clinical Research (or equivalent with advisor consent)

Specialty courses: Three specialty courses with an integrated focus are required. These courses and other electives are offered on the basis of interest, enrollment, and availability. Elective graduate-level courses at Tufts may be substituted based on a student’s needs. An individual course of study is arranged with the program adviser.

Certificate of Advanced Study in Pain Topics for Occupational Therapists
The Certificate of Advanced Study in Pain Topics in Occupational Therapy is designed for occupational therapists looking to fill a gap in knowledge on pain management. The certificate mirrors the Tufts University School of Medicine (TUSM) graduate program in Pain Research, Education and Policy. Both programs are built on the premise that pain is a bio psychosocial phenomenon and as such, its management ought to be influenced by a variety of factors ranging from neuroanatomy to social and economic issues. Students are exposed to a dynamic and richly rewarding educational experience. All OT-PREP students complete a total of five credit hours to earn the TUSM certificate. Licensed occupational therapists and students enrolled in the Tufts University Graduate Degree Program in Occupational Therapy are invited to enroll in the Tufts TUSM Certificate of Advanced Study in Pain Topics (www.tufts.edu/med/prep). A baccalaureate degree is required for admission.

The certificate requires five courses as follows:
- OTS 293 (fall) or 294 (spring): Special Topics (1 credit)
- OTS 234 (fall) or 235 (spring): Practicum Course (1 credit)
- PREP 230: Neuroanatomy, Neurochemistry and Pharmacology of Pain (1 credit)
- PREP 232: Ethical and Sociocultural Aspects of Pain (1 credit) OR PREP Elective/s with OT advisor consent (1 credit)
- PREP 234: Introduction to Clinical Pain Problems (1 credit)

For further information and an application, contact TUSM, Public Health and Professional Degree Programs, Certificate of Advanced Study in Pain Topics, at 617-636-0935 or med-phpd@tufts.edu.

ADMISSION
All applications for admission with requests for university-based financial aid, including scholarships and assistantships, must be submitted in a complete form by January 15 for fall entry. For complete information on the application process, visit http://ase.tufts.edu/bsot.
ACCREDITATION AND CERTIFICATION

The Entry Level Occupational Therapy Program is accredited by the Accreditation Council for Occupational Therapy Education (ACOTE) of the American Occupational Therapy Association (AOTA), located at 4720 Montgomery Lane, P.O. Box 31220, Bethesda, MD 20824-1220, Web: www.AOTA.org.

Graduates of the entry-level master’s program will be able to sit for the national certification examination for occupational therapists administered by the National Board for Certification in Occupational Therapy (NBCOT). For information about the national certification examination, please contact NBCOT, 12 South Summit Avenue, Suite 100, Gaithersburg, MD 20877-4150, phone 301-990-7979, fax 301-869-8492, or visit www.nbcot.org.

After successful completion of this examination, the individual will be certified as an Occupational Therapist, Registered (OTR). In addition, most states require licensure in order to practice. For specific information on individual state licensure procedures, see www.AOTA.org.

POLICIES AND PROCEDURES

Exemption from Courses
A student may be exempt from a required occupational therapy course on satisfactory completion of an equivalent course in terms of content knowledge and experiential learning. The student must demonstrate proficiency in the area to the course instructor. Satisfactory completion of proficiency will be determined by the individual instructor. A petition for variance from department requirements must be completed. Upon approval, the student can substitute an elective for the required degree credit.

Leaves of Absence
To be granted a leave of absence, students must petition, in writing (http://gradstudy.tufts.edu/studentservices/forms.htm), their advisor and departmental chair. The request must be accompanied by a letter of support from the student’s academic advisor. Each request is treated on its individual merit. The departmental policy states that no more than a one-year leave of absence may be granted from the academic portion of the program; it also states that each entry-level masters student must complete the six months of Level II fieldwork required for the degree no later than twenty-four months following completion of academic preparation.

Acceptable Grades
Graduate students are expected to achieve a grade of B- or better in all courses. Courses completed with less than a B- may be retaken only once. The original grade earned remains on the student’s academic record. If a student obtains two grades of less than B-, the student’s performance will be reviewed by the department. This will usually result in a recommendation to the dean that the student be administratively withdrawn from the program. Only the dean of the Graduate School of Arts and Sciences may administratively withdraw an enrolled student.

Grades of Incomplete
Students may not enter an occupational therapy course with an incomplete or an unsatisfactory grade in a prerequisite course. Grades of incomplete are not automatically given. The student who desires an extended time period in which to complete the semester’s work in a particular course must negotiate an incomplete with the instructor. This negotiation must be completed by the final class meeting of the course. Normally course work must be completed six weeks into the following semester. It is the responsibility of the student to ensure that course work is completed and that the process to update the transcript is followed through to completion.

Students who, due to extenuating circumstances, are not able to comply with any of the above grade policies may petition the Department of Occupational Therapy Academic Review Committee for a variance.

Withdrawals
A student is allowed no more than one withdrawal from any required or elective class after the add-drop period. Graduate students are not allowed to repeat the same course more than once; the student’s performance will be reviewed by the department. Withdrawal in any semester from two or more required courses after the add-drop period will usually result in a recommendation to the dean that the student be administratively withdrawn from the program. Only the dean of the Graduate School of Arts and Sciences may administratively withdraw an enrolled student.
**Required Occupational Therapy Courses**
Students will take professional courses in accordance with the Accreditation Council for Occupational Therapy Education (ACOTE) Standards of an Accredited Educational Program.

**Fieldwork**
The Accreditation Council for Occupational Therapy Education (ACOTE) and the National Board for Certification in Occupational Therapy (NBCOT) require the completion of all academic program requirements including the equivalent of a minimum of six months of supervised Level II fieldwork as a prerequisite to taking the certification examination. Tufts requires that Level II fieldwork placements be successfully completed within 24 months following completion of academic preparation as entry-level occupational therapy program degree requirements. Two Level II fieldwork placements are arranged with students through the department's fieldwork office. In addition to these placements, students participate in approximately 80 hours of course-related Level I fieldwork concurrent with specific courses arranged by the fieldwork coordinators. Placements for Level I and II fieldwork are subject to availability at locations that have contracts with Tufts-BSOT. The availability of specific sites and locations that offer fieldwork opportunities varies from semester to semester.

For more detailed information, please visit the website [http://ase.tufts.edu/bsot](http://ase.tufts.edu/bsot).
Occupational Therapy Certificate Program

FACULTY ADVISOR:
Professor Sharan L. Schwartzberg, Occupational Therapy

Occupational therapists are confronted with administrative and supervisory responsibilities and the need for increased specialization. Areas of practice such as hand and upper extremity rehabilitation, school-based practice, home care for the elderly, mental health, and community services expect extraordinary growth. To help occupational therapists meet these demands, Tufts Department of Occupational Therapy (http://www.ase.tufts.edu/occupationalTherapy/programs/certificate.htm) offers part-time certificate programs in hand and upper extremity rehabilitation, school-based practice, and a general certificate tailored to individual student learning needs.

The certificate program is open to those with a bachelor’s, master’s, or doctoral degree in occupational therapy. The program is especially designed for occupational therapists who are interested in expanding their careers, fieldwork educators, administrators, clinical specialists, and supervisors as well as seasoned professionals eager to strengthen their expertise.

For more information, contact the program administrator, Angela Foss, (Angela.Foss@tufts.edu) at 617-627-2320, or visit http://asegrad.tufts.edu/academics/explore-graduate-programs/occupational-therapy.

CERTIFICATE OF ADVANCED STUDY IN PAIN TOPICS FOR OCCUPATIONAL THERAPISTS
The Certificate of Advanced Study in Pain Topics in Occupational Therapy is designed for health care professionals looking to fill a gap in knowledge on pain management. The certificate mirrors the Tufts University School of Medicine (TUSM) graduate program in Pain Research, Education and Policy (PREP). Both programs are built on the premise that pain is a biopsychosocial phenomenon and as such, its management ought to be influenced by a variety of factors ranging from neuroanatomy to social and economic issues. Students are exposed to a dynamic and richly rewarding educational experience. All OT-PREP students complete a total of five credit hours to earn the TUSM certificate.

Licensed occupational therapists and students enrolled in the Tufts University Graduate Degree Program in Occupational Therapy are invited to enroll in the TUSM Certificate of Advanced Study in Pain Topics (www.tufts.edu/med/prep). A baccalaureate degree is required for admission.

The certificate requires five courses as follows:

- **OTS 293 or 294:** Special Topics (1 credit)
- **OTS 234, 235:** Practicum Course (1 credit)
- **PREP 230:** Neuroanatomy, Neurochemistry and Pharmacology of Pain (1 credit)
- **PREP 232:** Ethical and Sociocultural Aspects of Pain (1 credit) OR PREP Elective/s with OT advisor consent (1 credit)
- **PREP 234:** Introduction to Clinical Pain Problems (1 credit)

For further information and an application, contact TUSM, Public Health and Professional Degree Programs, Certificate of Advanced Study in Pain Topics, at 617-636-0935 or med-phpd@tufts.edu.
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CLASS YEAR ABBREVIATIONS
A College of Liberal Arts
D Dental School
E Engineering School
F Fletcher School
G Graduate School
H Honorary Degree
J Jackson College
M Medical School
N Friedman School of Nutrition Science and Policy
P Parent of Student
V Cummings School of Veterinary Medicine

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The planet faces a set of interrelated challenges related to violence and war, peacemaking and peacebuilding, justice and human rights and, increasingly, environmental degradation and climate change. The Peace and Justice Studies Program (PJS) provides students with an interdisciplinary course structure which examines the obstacles, conditions, and paths to addressing these challenges. It also explores the ways that governmental and nongovernmental organizations, social movements, and individuals have confronted such problems and worked to resolve them. This structure is also designed to develop students’ critical and analytical skills as well as competencies in fields that contribute towards peace and social transformation.

Five overlapping areas of study are emphasized:
1. The causes of war, the techniques of war prevention, and the conditions and structures of a just peace.
2. The meaning of justice, the means to achieve justice, and the relationship between justice and peace.
3. The theory and practice of conflict resolution operating along a continuum from individual disputes to international diplomacy.
4. The relationship between violence and peace in culture, with particular emphasis on investigating the traditions of nonviolence and on understanding ethical social behavior.
5. The origins, strategies, and visions of social movements and their relationship to other means of social change agency, such as community organizing, Internet activism, civic engagement, corporate social responsibility, social entrepreneurship, and institutionalized processes such as elections and lobbying.

PJS nurtures an active sense of social responsibility for the human condition, and encourages students to participate actively in developing their education by combining their talents and imagination through formal study and experiential education. The program presents a broad range of educa-
tional events and co-curricular activities which promote an engaged intellectual and civic climate on campus. In this sense, PJS fulfills the university’s mission and the liberal arts tradition by encouraging the student’s awareness, responsibility, and active engagement in the affairs of the world.

PJS offers both a major and a certificate. To fulfill requirements for the major, a student must complete eleven courses: the introductory course (PJS 1), one intermediate course in each of five core areas, an internship (PJS 99), the integrative seminar (PJS 190), and three elective courses on a particular theme to be chosen in consultation with the student’s PJS advisor. Students with a qualifying academic record are also encouraged to enroll in a senior honors thesis in Peace and Justice Studies (PJS 198).

To complete the certificate, a student must complete eight courses: the introductory course (PJS 1), an internship (PJS 99), the integrative seminar (PJS 190), one of two possible intermediate courses (PJS 120 or PJS 135), and four elective courses on a particular theme to be chosen in consultation with the student’s PJS advisor. Completion of the Peace and Justice Studies Certificate will be noted on the student’s transcript. Courses fulfilling the certificate requirements may also be used, where applicable, to meet major concentration or distribution requirements.
Philosophy

Associate Professor Erin Kelly, Chair; Ethics, political philosophy, philosophy of law
Professor Jody Azzouni, Philosophy of language, philosophy of logic, philosophy of mathematics, philosophy of science, metaphysics

Professor Nancy Bauer, Dean of Academic Affairs for Arts and Sciences; Feminism, modern European philosophy, philosophy and film
Professor Daniel C. Dennett, University Professor; Austin B. Fletcher Professor of Philosophy; Co-Director, Center for Cognitive Studies; Philosophy of mind, philosophy of psychology
Professor Ray Jackendoff, Seth Merrin Professor of Philosophy; Co-Director, Center for Cognitive Studies; Linguistics, cognitive science

Professor George E. Smith, Philosophy of science, logic
Professor Stephen L. White, Philosophy of mind, epistemology, meta-ethics, aesthetics
Associate Professor Avner Baz, Ethics, aesthetics, epistemology, Kant, Wittgenstein, ordinary language
Associate Professor Patrick Forber, Philosophy of biology, philosophy of science, philosophy of probability
Associate Professor Lionel McPherson, Ethics, political and social philosophy
Associate Professor Sigrún Svavarsdóttir, Moral philosophy, practical rationality
Assistant Professor Brian Epstein, Metaphysics, philosophy of language, philosophy of social science
Assistant Professor Dilip Ninan, Philosophy of language, metaphysics, philosophy of mind
Assistant Professor Christiana Offert, Ancient philosophy, early modern philosophy, ethics
Research Professor Peter Levine, Public policy, civic engagement
Visiting Professor Mario De Caro, Naturalism, ethics, free will, philosophy of mind
Visiting Professor Amelie Rorty, (history of ethics and moral psychology; ancient philosophy; political theory; literary and art criticism)

Senior Lecturer David Denby, Metaphysics, philosophy of language, ethics
Senior Lecturer Susan Russinoff, Philosophy of language, logic, philosophy of logic, history of logic, critical thinking pedagogy

Philosophy courses are for students majoring in any field who wish to enrich their education with a deeper understanding of themselves, the world they experience, and the reality underlying this experience, by a study of speculative and critical traditions in Western thought. The philosophy major provides a means of integrating broad education in the liberal arts via systematic and historical study of problems that arise in metaphysics, ethics, and epistemology, as well as in the foundations of other fields of inquiry. It is an appropriate major for those who enjoy thinking carefully and logically about basic issues and for those who seek breadth of educational experience prior to entering professional programs, such as law or medicine, or undertaking graduate study in some other areas. Non-majors may engage in a philosophical study of problems and concepts from their own fields by taking related courses in philosophy, such as feminist philosophy, philosophy of science, philosophy of language, and philosophy of mind; or they can acquire an elementary knowledge of the field by taking a philosophy course numbered below the 100 level.

UNDERGRADUATE CONCENTRATION
REQUIREMENTS
Major: ten courses, including:
  • Phil 1
  • At least one course in logic; Phil 33 or Phil 103 or another 100-level Logic course
  • At least one course numbered 100 or above in each of the following areas:
    1. History (ancient through early 20th-century, including phenomenology and early analytic philosophy)
    2. Value Theory (including moral philosophy, social and political philosophy, and aesthetics)
    3. Metaphysics and Epistemology (including philosophy of language, philosophy of mind, and philosophy of science)

See the Philosophy Department website for approved courses for each area.
• One 100-level seminar (which can also count for any of the above requirements and which must be drawn from among Phil 187, 188, 191, 192, 197, or, under appropriate circumstances, 195, 291, or 292). Students planning to undertake graduate work in philosophy are urged also to (1) write a senior honors thesis in Philosophy and/or (2) petition to take Phil 297, Graduate Writing Seminar.

• Four elective courses.

Students may count no more than five courses numbered below 100 for the major. At least seven courses constituting a Philosophy major must be offered or cross-listed by the Tufts Philosophy Department.

CERTIFICATE PROGRAM IN ETHICS, LAW, AND SOCIETY
The goal of the Certificate Program in Ethics, Law, and Society is to use philosophy to prepare students to be active citizens in leadership positions in government, non-governmental organizations, and the private sector. Students will learn about how moral and political philosophy relate to questions of public importance. The program focuses on how to use philosophy to think, argue, and write clearly and insightfully about these ethical questions.

Requirements for the certificate include six courses and an individual research project. The certificate program is in addition to a student’s concentration (or major), and no more than half of the courses used to fulfill the certificate requirements may be used to fulfill concentration requirements.

The six courses required for the certificate are as follows:
1. An introductory course (below 100-level) in philosophy
2. One or two upper-division courses (100-level or above) in ethical theory
3. One or two upper-division courses (100-level or above) in political philosophy or the philosophy of law
4. One or two courses in applied ethics (includes Phil 24, 43, 48, 124, 125)

The individual research project is initiated during the Ethics, Law and Society seminar and extends six weeks into the spring semester.

UNDERGRADUATE MINOR PROGRAMS
For more detailed information on minor programs administered by the Philosophy Department, please visit the Department website: http://as.tufts.edu/philosophy/undergraduate/minor.

Minor in Philosophy
The minor in Philosophy requires the completion of six courses, including:
1. One of Phil 1, 3, 6, 24, 33, 39, 43, or 48
2. Two Philosophy courses at the 100 level
3. Three other Philosophy courses

Minor in Cognitive and Brain Sciences (administered through the Center for Cognitive Studies)
The minor in Cognitive and Brain Sciences requires seven courses. At least five of these must be in departments different from the student’s major.
The selection of courses must be approved by the student’s advisor.

1. PSY 9, Introduction to Cognitive and Brain Sciences
2. PHIL 15, Introduction to Linguistics, and/or COMP 15, Data Structures
3. PSY 195, Senior Seminar in Cognitive and Brain Sciences (full year, one course credit.
4. The remainder of the seven courses are to be selected from at least two of the following groups:

a. Psychology courses
   PSY 11 Developmental Psychology
b. Philosophy, Linguistics and Psycholinguistics courses
PHIL 3 Language and Mind
PHIL 33 or 103 Logic
PHIL 38 Rational Choice
PHIL 110/PSY 153 Biological Foundations of Language
PHIL 111/PSY 150 Semantics
PHIL 112/PSY 151 Syntactic Theory
PHIL 113/PSY 132 Cognition of Society and Culture
PHIL 114 Topics in Logic
PHIL 117 Philosophy of Mind
PHIL 126 Theories of Human Nature
PHIL 133 Philosophy of Language
PHIL 134 Philosophy of Social Science
PHIL 170 Computation Theory
PHIL 191 Foundations of Cognitive Science
PSY 149 Psychology of Language
PSY 152 Psychology of Bilingualism
PSY 155 Phonological Theory
CD 152 Development of Thought and Language
CD 155 The Young Child’s Development of Language
CD 177 Bilingual Studies
CD 195 Developmental Disorders in Language and Reading
CD 243 Reading, Dyslexia, and the Brain
ED/ML/GER 114 Linguistic Approaches to Second Language Acquisition

c. Computer Science courses
COMP 131 Artificial Intelligence
COMP 135 Machine Learning and Data Mining
COMP 150 BBR Behavior-Based Robotics
COMP 150 MOD Computational Models in Cognitive Science
COMP 170 Computation Theory
COMP 171 Human Computer Interaction

Other courses may be admitted for the minor with the approval of the student’s advisor and advisor notification of the DARS coordinator at Student Services.
Minor in Linguistics  
(administered through the Center for Cognitive Studies)

The minor in Linguistics has three components. First, it offers students a grounding in contemporary linguistic theory and its constituent domains of phonology (sound structure), morphology (word structure), syntax (grammatical structure), and semantics (the structure of meaning), with attention to a great variety found among languages of the world. Second, the minor addresses the interaction of the study of language with fields as diverse as philosophy, literature, child development, neuroscience, and evolutionary theory. Third, as part of the appreciation of linguistic diversity, the minor requires students to develop proficiency in one or more foreign languages.

Language Requirement: Students may not use the Culture Option to fulfill Part 2 of the Arts and Sciences Foreign Language Requirement; they must either complete six semesters (or equivalent) of one foreign language, or three semesters each (or equivalent) of two foreign languages.

The selection of courses must be approved by the student's linguistics advisor. Students may petition their advisor to include other courses in category 3.

In addition to the language requirement, the minor in Linguistics requires six courses, of which no more than two may also be used toward the student's major.

***AFFILIATED FACULTY INCLUDE:***

Maryanne Wolf, Child Development
Chip Gidney, Child Development
Gregory Crane, Classics
Anne Mahoney, Classics
John Fyler, English
Hosea Hirata, GRALL
Saskia Stoessel, GRALL
John Julian, Romance Languages
Ray Jackendoff, Co-Director; Philosophy
Daniel Dennett, Philosophy
Ariel Goldberg, Co-Director; Psychology
Philip Holcomb, Psychology
Gina Kuperberg, Psychology

The minor in Linguistics requires six courses, including:

1. LING 15/PHIL 15/PSY 64 Introduction to Linguistics

2. Two of the following:
   - LING 112/PHIL 112/PSY 151 Syntactic Theory
   - LING 113/PHIL 111/PSY 150 Semantics
   - LING 155/PSY 155 Phonological Theory

3. Three of the following:
   - A third course from category 2
   - LING/PHIL 3 Language and Mind
   - LING/PHIL 33 or 103 Logic
   - LING 92/ML 96 Romance Linguistics
   - LING 101/ENG 101 Old English
   - LING 114/ED/ML/GER 114 Linguistic Approaches to Second Language Acquisition
   - LING/PHIL 133 Philosophy of Language
   - LING 137/ANTH 137 Language and Culture
   - LING/PSY 149 Psychology of Language
   - LING/PSY 152 Psychology of Bilingualism
   - LING 153/PHIL 110/PSY 153 Biological Foundations of Language
   - LING 155/CD 155 The Young Child's Development of Language
   - LING 71/CLS 71 Historical Linguistics
   - LING/CLS 170 Indo-European Linguistics
   - LING 177/CD 177 Bilingual Studies
GRADUATE PROGRAM
The program leading to the Master of Arts degree in Philosophy is intended primarily for the student who is considering advanced work in philosophy but who did not concentrate in the subject as an undergraduate. Typically, students admitted to the program plan to pursue a doctorate in philosophy (Tufts itself does not offer a doctorate in the field), though some students have other career plans.

The department’s offerings range across the major areas of interest in contemporary philosophy. Each year at least four seminars are offered, typically on instructors’ current research interests. The department has particular strengths in the following areas: contemporary ethical theory, social and political philosophy, metaphysics and epistemology, philosophy of language and philosophical logic, philosophy of mind, and philosophy of science.

Master’s candidates receive individual attention from members of the department in their specialized fields and have an opportunity to participate in the philosophical life of the department. The department has a lecture series, which brings six to eight eminent speakers to Tufts each year, and it sponsors other departmental events. Students also have access to the very active philosophical community in the Boston area.

The program leading to the degree of Master of Arts in philosophy is designed to be completed over four terms. Requirements are as follows:

Program Requirements

SUMMARY
The Master’s in Philosophy requires completing eleven courses (worth eleven credits). Coursework must satisfy a breadth requirement. Students must also pass an Area of Strength Exam. See below for a more detailed description of these requirements.

COURSEWORK
The coursework consists of eleven (11) upper-level philosophy courses (courses numbered 100 or above). Thus, students must earn eleven (11) credits. We do not accept transfer courses.

The eleven (11) courses must include:

• Phil 103 Logic
  Students with proven strength in logic may be able to be exempt from the logic requirement.
• Phil 297 Graduate Writing Seminar
  This course is designed to help students prepare a writing sample in order to apply to doctoral programs.

Coursework must satisfy a breadth requirement. Two courses are required in each of these three (3) areas:
1. Normative philosophy
2. History of philosophy
3. Metaphysics and epistemology

All upper-level philosophy courses, except the graduate writing seminar, fall into at least one of three distribution areas. See the Course Distribution list found on the Department of Philosophy website (http://as.tufts.edu/philosophy/sites/all/themes/asbase/assets/documents/gradMAcourseDistributionList.pdf) for allocation.

Students are not required to concentrate their coursework in a particular area. Nonetheless, students may well focus more on some areas but not others in the courses they take. While deciding which courses to take, students should be aware that some are offered regularly and some are not.
Area of Strength Exam
In addition to coursework, students must also pass one of three “area of strength” exams. The exams are:

1. Ethics
2. Epistemology
3. Metaphysics

Before the start of each academic year, a list of topics and/or core texts for each of the exams will be made available. This content will vary from year to year.

Students should take the exam in their second or third semester. Before taking the exam of their choice, they must have completed a course in that area. Students must register for the “area of strength exam” course during the semester in which they plan to take the exam. The “area of strength” course has no designated course content and is, in effect, a transcript record of when the exam was taken. It is not worth any credits.
Within the liberal arts framework at Tufts University, the physical education program offers students instruction in individual, dual, and group activities that promote lifelong fitness and enjoyment. Courses in aquatics, racquet sports, fencing, aerobics, physical fitness, and outdoor education are some examples of the diverse offerings of the department. Approximately 50 courses are scheduled each academic year, and most courses are offered fall and spring semesters. Every effort is made to maintain limited enrollment in all courses, to provide each student with maximum personal attention from the instructors.

One-half academic credit is granted for courses that are skill-oriented, and a total of two such credits may be applied toward the total for the degree. Introductory level courses are offered on a pass-fail basis. Theory classes of one course credit are applicable toward the degree. No advanced placement or retroactive credit will be given for any physical education courses.
Athletics has been an important part of life at Tufts throughout its history. The athletic program provides students the opportunity to compete in both intercollegiate and intramural sports, and also to engage in general recreation. Tufts fields seventeen varsity teams for men and women, supports eight club sports organizations, and offers several intramural sports programs.

For more detailed information, please visit the Physical Education website http://ase.tufts.edu/physed/.

For more detailed information about athletics programs, please visit the Athletics website http://gotuftsjumbos.com/.
Physics and Astronomy

Professor Hugh Gallagher, Chair; Experimental high-energy physics
Professor Peggy Cebe, Experimental condensed matter polymer physics
Professor Lawrence H. Ford, Cosmology, general relativity, astrophysics
Professor Gary R. Goldstein, Theoretical high-energy physics
Professor Kenneth R. Lang, Astronomy
Professor W. Anthony Mann, Experimental high-energy physics
Professor Austin Napier, Experimental high-energy physics
Professor Krzysztof Sliwa, Experimental high-energy physics
Professor Roger G. Tobin, Experimental condensed matter physics, physics education
Professor Alexander Vilenkin, L. and J. Bernstein Chair in Evolutionary Science; Cosmology, general relativity, astrophysics
Associate Professor Peter Love, Quantum computing
Associate Professor Danilo Marchesini, Astronomy/astrophysics
Associate Professor Cristian Staii, Experimental condensed matter physics, biological physics
Assistant Professor Timothy Atherton, Theoretical condensed matter physics
Assistant Professor Pierre-Hugues Beauchemin, Experimental high-energy physics
Assistant Professor Mark Hertzberg, Cosmology, general relativity
Assistant Professor Anna Sajina, Astronomy/astrophysics
Research Professor Kenneth Olum, General relativity and cosmology, quantum field theory

SECONDARY APPOINTMENTS:
Professor Bruce Boghosian, Mathematics; quantum computing, fluid dynamics
Professor David Hammer, Education; science education
Adjunct Professor Fiorenzo Omenetto, Biomedical engineering; optical physics
Adjunct Professor Igor Sokolov, Mechanical engineering, nanomechanics, nanophotonics
Adjunct Associate Professor Thomas Vandervelde, Electrical and computer engineering, semiconductors, optoelectronics
Adjunct Senior Lecturer Robert F. Willson, Tufts University School of Medicine; Astronomy

The laws of physics are few in number yet appear to govern all known material phenomena: physical, chemical, and biological. The science of physics involves the observation of natural processes and the formulation from these observations of general principles that may be tested further or exploited for useful ends. Majoring in physics can be a valuable part of a broad education. Students who combine mastery of the basic laws of physics with the outlook and flexibility of a liberal education will be well prepared to take on a variety of specialized roles. Men and women who majored in physics in the recent past have successfully entered careers in physics, as well as in business administration, the computer industry, law, medicine, dentistry, meteorology, public health, and teaching.

UNDERGRADUATE CONCENTRATION REQUIREMENTS—COLLEGE OF LIBERAL ARTS

Minimum Grade Policy
A minimum GPA of 2.0 in the courses applied to a major, and no more than one course with a grade less than C-. This policy applies to all majors offered by the department for students entering September 2013 or later.

Major in Physics
Eight courses in physics more advanced than Physics 2 or 12 and including Physics 13 and 64; two courses in mathematics more advanced than Mathematics 42 and 44 (previously 13 and 18). With the exception of Physics 13 and 64, two of the physics courses and one mathematics course may be replaced by approved advanced courses in related fields (such as astronomy, biology, chemistry, computer science, engineering, or mathematics). The ten courses required for the major must include two courses in advanced
laboratory training. One of these courses must be Physics 64; the other may be Physics 31 or 41.

**Major in Applied Physics**

Five courses in physics more advanced than Physics 2 or 12, including Physics 13 and 64; two courses in mathematics more advanced than Mathematics 42 and 44 (previously 13 and 18); three courses from the concentration requirements of one of the engineering departments. With the exception of Physics 13 and 64, one of the five physics courses may be replaced by an approved course in a related field.

**Major in Chemical Physics**

Foundation: Chemistry 1, 11, or 16; Chemistry 2 or 12; Physics 1 or 11; Physics 2 or 12. Concentration: Ten credits of more advanced, one-credit courses: four credits in Chemistry (with a prerequisite of Chem 2 or 12), four credits in Physics (with a prerequisite of Phys 2 or 12), and two credits in mathematics (Math 70 or courses with a prerequisite of Math 42, 44, or 70—previously 13, 18, or 46, respectively). The courses must include the following: Physics 13; one credit in advanced laboratory training, either Physics 64 (counts as one advanced physics course) or both Chemistry 33 and 34 (counts as one advanced chemistry course); either Chemistry 31 or Physics 52; either Chemistry 32 or Physics 61; and either Chemistry 51 or Chemistry 61.

**Major in Astrophysics**

Four courses in physics more advanced than Physics 2 or 12, including Physics 13 and either Physics 31 or 64; two courses in mathematics more advanced than Mathematics 42 and 44 (previously 13 and 18); four courses in astronomy more advanced than Astronomy 9 and 10. One mathematics course, and either one physics course or one astronomy course, may be replaced by an approved advanced course in a related field. Research experience is strongly recommended.

**Note to Premedical, Predental, and Preveterinary Students**

Students interested in entering medical, dental, or veterinary school after graduation may take advantage of the following replacement option to complete the corresponding entrance requirements as part of the physics major. With the exception of Physics 13 and 64, two of the physics courses and one mathematics course may be replaced by Chemistry 51 and 53 and 52 and 54, and one other advanced elective. Chemistry 53 and 54 will also fulfill one term of the advanced laboratory training requirement for the physics major.

**UNDERGRADUATE CONCENTRATION REQUIREMENTS—SCHOOL OF ENGINEERING**

**Bachelor of Science in Engineering Physics**

A minimum of 38 credits is required: introductory (10 credits), humanities/arts/social science (6 credits), free elective (2 credits), foundation (8 credits), and a physics/engineering concentration requirement (12 credits).

The introductory requirement includes Physics 11 and 12.

The foundation requirement comprises Physics 13, Physics 32, Physics 52, Physics 41 (or ES 3 and ES 4); two courses from Engineering Science 3, 4, 5, 8, or 9; plus two other courses satisfying the foundation requirements of the School of Engineering.

The concentration requirement comprises four courses in physics and astronomy at the intermediate or advanced levels, which must include Physics 64; four courses from the concentration requirements of one of the engineering departments; and four approved elective courses in computer science, engineering, mathematics, or science.

**UNDERGRADUATE MINOR PROGRAM**

The program requires the completion of five courses, with a minimum grade of C-.

Prematriculation credits may not be applied towards the requirements for the minor.
Minimum grade policy applies to students entering September 2013 or later.

**Physics Minor**
Five courses in physics, which must include Physics 13. The other courses may be selected from among Physics 11, 12 (or 1, 2), and courses in physics numbered 15 or higher.

**Astrophysics Minor**
Five courses, at least three of which must be courses in astronomy numbered 15 or higher. The remaining courses may be selected from among Physics 11, 12 (or 1, 2), 13, and courses in physics or astronomy numbered 15 or higher.

**GRADUATE PROGRAM**
The Department of Physics and Astronomy grants two degrees: the Doctor of Philosophy and the Master of Science. The department has established qualifications to ensure that degree candidates have a broad background in experimental and theoretical physics. A faculty advisory committee is appointed for each student to supervise the program of study leading to the degree.

**Master of Science**
The Master of Science degree requires eight graduate-level courses in physics or related fields, the latter to be subject to approval by the advisory committee. These courses must include Physics 131, 145, 146, 163, and 164, and must be completed with a grade of B- or better. The student has the option of writing and defending a Master’s thesis, which may count as the equivalent of up to three courses.

**Master of Science, Astrophysics Track**
The curriculum requirements consist of seven core courses and one elective course. A minimum of eight courses are required. Any exceptions or substitutions must be approved by the student's advisory committee.

- The core program consists of seven Physics and Astronomy courses: Physics 131, 145, 163, and 153; Astronomy 121 and 122; and Physics 146 or 164 or a course in radiative processes in astrophysics which could be taken at another institution. The additional graduate-level elective must be approved by the student's advisory committee.

**Master of Science, Physics Education Track**
A minimum of ten courses are required. Any exceptions or substitutions must be approved by the student's advisory committee.

- The core program consists of eight courses, four in Physics and Astronomy (Physics 131, 145, 153, and 163) and four in education (Education 111, Education 130, one foundations course, and one credit (two semesters) of proseminar). Additionally, two elective courses from Physics & Astronomy must be selected in consultation with the student's advisory committee.

Successful completion of the course requirements shall satisfy the requirements for a Master of Science degree.

**Doctor of Philosophy**
The doctoral candidate must demonstrate proficiency in four core fields: classical mechanics, classical electromagnetism, statistical mechanics, and quantum mechanics, either by achieving satisfactory grades in the relevant courses (A- or better in Physics 131 and 153; A- or better average in the sequences Physics 145/146 and Physics 163/164) or through special examinations in those fields. However, a student whose average grade in classical mechanics (131) and classical electromagnetism (145, 146) is at least A- (3.67) will be exempt from the examinations in both subjects. Similarly, a student whose average grade in statistical mechanics (153) and quantum mechanics (163 and 164) is at least A- (3.67) will be exempt from the examinations in both of those subjects. Graduate courses taken at other institutions may in some cases be used to fulfill
part of this requirement.

The doctoral candidate must also complete courses in any two of five specialized fields: astronomy/astrophysics (121 or 122), condensed matter physics (173 or 174), particle physics (183 or 184), general relativity and cosmology (167 or 268), and advanced quantum mechanics (263).

By the end of the second year, the candidate must choose a field of specialization and obtain a research advisor. The current research areas in the department are astronomy and astrophysics, biophysics, condensed matter physics, cosmology, general relativity, particle physics, and physics education.

By the end of the third year, the candidate must have completed the basic proficiency requirement and taken an oral examination in the chosen specialized field. Satisfactory performance on the oral examination qualifies the candidate to undertake a program of independent research under the guidance of the research advisor, culminating in the preparation and defense of a doctoral dissertation.

**Doctor of Philosophy, Astrophysics Track**

Students who wish to pursue the doctorate must complete the course requirements for the Master of Science in the Astrophysics track and fulfill additional requirements.

The doctoral candidate must demonstrate proficiency in five core fields: classical mechanics, classical electromagnetism, statistical mechanics, quantum mechanics, and astronomy, either by achieving satisfactory grades in the relevant courses (A- or better in Physics 131, 153, 145, 163; A- or better average in the sequence Astronomy 121/122) or through special examinations in those fields. However, a student whose average grade in classical mechanics (131) and classical electromagnetism (145) is at least A- (3.67) will be exempt from the examinations in both subjects. Similarly, a student whose average grade in statistical mechanics (153) and quantum mechanics (163) is at least A- (3.67) will be exempt from the examinations in both those subjects. Graduate courses taken at other institutions may in some cases be used to fulfill part of this requirement.

By the end of the third year, the candidate must have completed the basic proficiency requirement and taken an oral examination in astrophysics. Satisfactory performance on the oral examination qualifies the candidate to undertake a program of independent research under the guidance of the research advisor, culminating in the preparation and defense of a doctoral dissertation.

**Doctor of Philosophy, Chemical Physics Track**

The curriculum requirements for the Chemical Physics track meld those of Chemistry with those of Physics. The curriculum has more emphasis on chemical synthesis than the core program in Physics and more electricity and magnetism than the core program in Chemistry. These greater core requirements are balanced with a greater flexibility in the elective courses.

The core program consists of seven graduate-level classroom courses, at least three of which must be Chemistry courses (Chem 133, 136, or 131 and at least one of 150, 151, 152, 161 and 162) and three must be Physics courses (163, 164, or 153). These are to be completed by the fourth semester in residence. Additionally, two elective courses must be chosen from Chemistry 132, 151, or 162 or Physics 131, 146, 173 or 174. Other appropriate courses may be substituted with the approval of the student's advisory committee.

Two oral presentations are required: a public seminar by the end of the fourth semester and a presentation to the student's research committee in the fifth semester. The seminar is based on current literature, can be presented in either department, and is evaluated by the research committee. The topic for the presentation to the committee is chosen by the student in consultation with the research committee. This presentation may be waived for students having at least a 3.3 average in the core courses. In addition, the student must prepare a written, original research proposal by the end of the eighth semester. This proposal shall be somewhat distinct from the thesis work and defended orally before the advisory committee.
**Doctor of Philosophy, Physics Education Track**

The curriculum requirements for the Physics Education track meld those of Education with those of Physics and Astronomy. The student’s faculty advisory committee will consist of at least one member from the Education department and one from the Physics and Astronomy department in addition to the research advisor.

Students who wish to pursue the doctorate must complete the course requirements for the Master of Science in the Physics Education track and fulfill additional requirements.

The doctoral candidate must demonstrate proficiency in four core fields of physics: classical mechanics, classical electromagnetism, statistical mechanics, and quantum mechanics, either by achieving grades of A- or better in the core physics courses or through special examinations in those fields. However, a student whose average grade in classical mechanics (131) and classical electromagnetism (145) is at least A- (3.67) will be exempt from the examinations in both subjects. Similarly, a student whose average grade in statistical mechanics (153) and quantum mechanics (163) is at least A- (3.67) will be exempt from the examinations in both of those subjects.

Following completion of the core courses, the doctoral student shall complete:

- An oral qualifying examination in physics, similar to that required of other physics doctoral students. This should ordinarily be completed in the third year.
- A written dissertation proposal, also presented orally to the advisory committee. This should ordinarily be completed in the fourth year.

For more detailed information, please visit the website [http://ase.tufts.edu/physics](http://ase.tufts.edu/physics).
Political Science

Professor Deborah J. Schildkraut, Chair; American politics, political psychology, political behavior, racial and ethnic politics

Professor Jeffrey M. Berry, John Richard Skuse, Class of 1941, Professor of Political Science; American politics, political behavior

Professor Robert Devigne, Political theory

Professor Ioannis Evrigenis, Political theory

Professor James M. Glaser, Dean of Academic Affairs for the Arts and Sciences; American politics, political behavior

Professor Malik Mufti, International relations, comparative politics, Middle East

Professor Vickie Sullivan, Political theory

Associate Professor David Art, Comparative politics, political economy, Europe

Associate Professor Consuelo Cruz, Comparative politics, Latin America

Associate Professor Richard C. Eichenberg, International relations, foreign policy, political behavior

Associate Professor Kelly M. Greenhill, International relations, security studies

Associate Professor Natalie Masuoka, American politics, political behavior

Associate Professor Elizabeth Remick, Comparative politics, East Asia

Associate Professor Pearl T. Robinson, Comparative politics, Africa, African-American politics

Associate Professor Oxana Shevel, Comparative politics, post-Communist region

Associate Professor Jeffrey W. Taliaferro, International relations, security studies

Assistant Professor Michael Beckley, International relations

Assistant Professor Nimah Mazaheri, Comparative politics and political economy

The Department of Political Science is concerned with the functions and theory of the structure and operation of government, and the nature and development of local, national, and international politics. The goals of the department are both intellectual and practical. Courses are designed to develop an understanding of the political process, and an ability to critically analyze political systems, relationships, and problems. Courses are also intended to provide a basis for intelligent citizenship, increase capacity for community service, and orient the student toward possible employment in governmental agencies on the local, state, national, or international level. The undergraduate curriculum is structured to recognize that majors in political science will have a diversity of post-college goals. The department's offerings may be regarded as a foundation for graduate study preparatory to college teaching, professional government service, the law, and city and environmental planning, as well as for careers in such fields as public and business administration, journalism, secondary school teaching, nonprofit work, and social action.

UNDERGRADUATE CONCENTRATION

REQUIREMENTS

The major requires ten courses overall: two political science foundation courses and eight additional political science courses. Students are required to take at least one course in each of four subfields: American politics and government (or American public policy), comparative politics and government, international relations, and political theory and philosophy. Internships and directed research courses will not fulfill a subfield requirement.

All majors must also take at least one course designated as methodologically focused. These courses incorporate material that helps students to understand the logic of social science inquiry. Because these courses will improve students' comprehension of how social science research is conducted, they are advised to fulfill this requirement early in their course of study, preferably in the sophomore year.

Courses that have met this requirement in the past are:

PS 15 Sophomore Seminar: Politics in the City
PS 23 Sophomore Seminar: Political Economy of Latin America
PS 103 Political Science Research Methods
PS 104 Seminar: New Media, New Politics
PS 107 Political Participation and Mass Behavior
Each year, other courses may be designated as methodologically focused, and these additional options will also fulfill the requirement.

Please consult the course listings published by the department prior to preregistration for a complete listing of all methodologically focused courses.

Majors are also required to take one upper-level seminar in political science at Tufts’ Medford/Somerville campus. Sophomore seminars do not fulfill this requirement. Majors are required to take eight of the ten political science courses in the Tufts University Department of Political Science. All of the other requirements of the major—the two foundation courses, the course in each of the four major subfields, the methodologically focused course, and the advanced seminar—must also be fulfilled in the Tufts University Department of Political Science.

Majors are expected to complete their basic courses and declare their major by the end of the sophomore year. A grade of C- or better is required for a course to count toward the major. The department publishes requirements, programs, and additional information about the major on the department’s website at http://as.tufts.edu/politicalscience/undergraduate/major. New majors should familiarize themselves with this material.

UNDERGRADUATE MINOR PROGRAM
Students interested in completing a minor concentration in political science may choose from six different options: Political Science (general), American Politics, Comparative Politics, Foreign Policy Analysis, Political Economy, and Political Thought.

All of these minors require five courses in political science. Each of them, however, has separate requirements and a different list of courses. No student may take two minors. A detailed listing of these requirements is found on the website at http://as.tufts.edu/politicalscience/undergraduate/minor.

TUFTS-IN-WASHINGTON PROGRAM
The Tufts-in-Washington program offers students an opportunity for intensive firsthand study of government and politics during a semester’s residence in Washington, D.C. Undergraduates who are accepted to the program may elect either American national government or foreign policy as their field of concentration. Students are registered at Tufts and are billed all the costs of the program. This includes Tufts tuition, room, board, fees and medical insurance, if not waived by the student. Students are housed at American University in Washington, D.C., but all costs are billed by and payable to Tufts by the billing due date.

The Tufts-in-Washington program is administered by the Department of Political Science, but it is open to all Tufts undergraduates. A prerequisite for admission is a background in political science and other social science courses relevant to the student's plan of study in Washington.

Central to the curriculum during the Washington semester is a series of seminars with various Washington political elites and policy activists. Students also do individual research projects and participate as interns in the government or in the private sector. The Tufts-in-Washington seminars do not fulfill the upper-level seminar requirement for the political science major, which must be taken at Tufts’ Medford/Somerville campus. Interested students can find more information here: http://as.tufts.edu/politicalscience/undergraduate/tuftsInWashington.
In the government and nonprofit sectors, significant resources are devoted to programs that address compelling social needs. Evaluation of these programs can help them to grow and improve their operations. Yet agencies often resist evaluation because it is seen as politically risky or technically intimidating.

Private funders and public agencies are increasingly demanding evaluation as a provision for funding. Individuals with evaluation training are needed to assist programs, sponsoring agencies, and funders in planning and carrying out evaluations to address their needs for information and analysis.

The certificate in program evaluation is designed for midcareer professionals who wish to learn about the design and implementation of effective evaluation strategies. Students learn practical skills that can be put to use in the evaluation of a wide range of social service, public health, community development, and environmental programs.

Four courses are required for the certificate. The certificate is offered in collaboration with the graduate Departments of Child Study and Human Development and Urban and Environmental Policy and Planning in the School of Arts, Sciences, and Engineering, as well as the Friedman School of Nutrition Science and Policy, and the School of Medicine.

The program is open to individuals with a bachelor’s degree and three to five years of professional experience in a particular field. The program is particularly appropriate for agency directors and administrators, program managers and staff, foundation project officers, policy analysts, community organizers and advocates, human resources professionals, and educators.

For more information and/or an application, contact the program administrator, Angela Foss, at 617-627-2320 or visit the website at http://as.tufts.edu/uep/programs/certificate.
Psychology

Professor Lisa M. Shin, Chair; Clinical neuroscience
Professor Richard A. Chechile, Mathematical psychology, memory
Professor Robert G. Cook, Dean of Graduate School of Arts and Sciences; Animal cognition and learning
Professor Joseph F. DeBold, Endocrinology and behavior
Professor David W. Harder, Clinical psychology, personality assessment
Professor Phillip J. Holcomb, Cognitive neuroscience, language
Professor Robin A. Kanarek, John Wade Professor; Physiological psychology and nutrition
Professor Gina R. Kuperberg, Cognitive neuroscience, language (semantics), neuropsychiatry
Professor Klaus A. Miczek, Moses Hunt Professor of Psychology; Psychopharmacology
Professor Aniruddh Patel, Music cognition
Professor JP de Ruiter, Cognition and psycholinguistics
Professor Samuel R. Sommers, Director of Undergraduate Program; Social perception and judgment
Professor Holly A. Taylor, Spatial cognition, language, memory
Associate Professor Ariel M. Goldberg, Linguistics and psychology of language
Associate Professor Keith B. Maddox, Social cognition
Associate Professor Ayanna K. Thomas, Director of Graduate Program; Memory and aging
Associate Professor Heather L. Urry, Affective neuroscience
Assistant Professor Paul Muentener, Cognitive development
Assistant Professor Elizabeth Race, Cognitive neuroscience
Assistant Professor Jessica D. Remedios, Social cognition
Assistant Professor Nathan Ward, Applied cognition
Lecturer Alexander H. Queen, Clinical psychology
Research Professor Ray Nickerson, Cognition and human factors
Visiting Associate Professor Tad Brunye, Applied cognition
Visiting Scholar Katherine Midgley, Psychology of bilingualism

SECONDARY APPOINTMENTS:
Professor Ray Jackendoff, Philosophy; Linguistics and psychology of language
Professor Linda Tickle-Degnen, Occupational Therapy; Social functioning and wellness
Professor Matthias Scheutz, Computer Science; Artificial intelligence, robotics, cognitive science

Psychology concerns processes and principles of behavior. Increased understanding of oneself and others through the study of psychology is useful in almost any endeavor. The Psychology curriculum is diverse in order to reflect the breadth of the field, from the biological bases to the social determinants of behavior. Students gain general familiarity with psychology, and have the option to emphasize specific areas in the field. Courses are geared toward the development of evaluative and analytic skills, which are indispensable to advanced study in experimental, clinical, and applied psychology. These skills, together with knowledge of the factors influencing individual and group behavior, are highly valuable for careers in such fields as public health, engineering, medicine, business, administration, law, and education.

PSYCHOLOGY COURSES AS DISTRIBUTION REQUIREMENTS
Because Psychology courses span all five distribution areas, students are urged to check SIS and the department’s website listing of current course offerings for the most up-to-date information by distribution area. Most departmental courses count toward either the social sciences or natural sciences distributions.

UNDERGRADUATE CONCENTRATION REQUIREMENTS
The Psychology Department offers undergraduate majors in Psychology, Biopsychology, Clinical Psychology, Cognitive and Brain Science, and Engineering Psychology. Psychology, Biopsychology, Clinical Psychology, Cognitive and Brain Science, and Engineering Psychology majors may not double major in any of the other majors offered by the Psychology Department. Additional details regarding major requirements and policies can be found on-line in the department’s Undergraduate Handbook.
Major in Psychology

This major is intended for students interested in exploring a variety of topics in psychology. Eleven courses distributed as follows: Psychology 1; one course from among Psychology 11, 12, 13, 14, 15, and 17; one course from among Psychology 22, 25, 26, 27, 28, and 29; Psychology 31; Psychology 32; one advanced lab course from among Psychology 36, 37, 38, 40, 41, 42, 46, 48, and 49; two Psychology courses numbered above 100; one other departmental course (i.e., an elective); and two approved advanced courses in related fields.

Courses taken to fulfill the psychology major (including related-field requirements) normally may not be taken pass-fail. No more than two independent study courses (Psychology 91, 92, 97, 99, 191, 192, 197, 198, 199) may be counted toward the concentration requirements. Successful completion of a Senior Honors Thesis chaired by a member of the department (PSY 199) may substitute for the advanced lab requirement. No more than one course taken to fulfill the 100-level requirement may be an independent study course.

Students with a score of 4 or 5 on the AP in psychology place out of Psychology 1. An AP score of 5 completely substitutes for Psychology 1 within the major, meaning that a student needs only 10 additional courses to complete the major. An AP score of 4 places a student into two-digit psychology courses, but the student needs to take an additional psychology course for the major in lieu of Psychology 1. Successful completion of Child Development 1 is treated in the same manner as an AP score of 4: students may substitute CD 1 for PSY 1 for prerequisite purposes, but they must take an additional psychology course in order to reach the 11 courses required for the major.

Psychology 32 and the advanced lab must be completed at Tufts. Double majors in Psychology and Mathematics can use Math 162 as a substitute for Psychology 31. Students who are double majoring in Psychology and Economics can use Econ 13 as a substitute for Psychology 31. Students double majoring in Biology and one of the Psychology majors may use Bio 132 to fulfill their statistics requirement.

In recommending students for honors, in addition to the general college requirements, the department does not normally recommend students for highest honors unless they have done empirical research. Students graduating with a major in Psychology may choose either a B.A. or B.S.

Major in Clinical Psychology

This major is intended for students interested in entering graduate or professional schools in mental health or human services and/or working with psychiatric patients. Required courses are Psychology 1, 12, 31, 38, 71, 106, 181, and 182; two electives in psychology, one of which must be at the 100 level; and two approved advanced courses in related fields. Students graduating with a major in Clinical Psychology earn a B.A., unless they take Psychology 32, in which case they may choose either a B.A. or B.S.

Major in Biopsychology

This interdepartmental major, for students particularly interested in neurobiology and behavior, requires five courses in biology and five in psychology. These include the following: Cells and Organisms (Biology 13), General Genetics (Biology 41), Animal Behavior (Biology 130), one course in animal physiology (chosen from among Biology 75, 110, 115, 116, and 134) and an elective in biology; Statistics (Psychology 31 or Biology 132), Experimental Psychology (Psychology 32), Brain and Behavior (Psychology 103), plus two electives from among Psychology 22, 26, 27, 29, 40, 41, 42, 45, 46, 48, 49, 104, 112, 117, 123, 124, 127, 128, 129, 142, 143, 146, 148, 154, and 159. Additional courses may be added to this list at the discretion of the undergraduate committee. Students can earn 1 Tufts credit for PSY 25 or for PSY 103, but not separate credits for both courses. Students who took PSY 25 before declaring a biopsychology major should speak with their advisor about substituting an additional Psychology elective for the PSY 103 requirement.

Biopsychology majors may not also double major in psychology or biology. Majors are encouraged to elect an advanced laboratory course in either department, and independent research is strongly encouraged, but is not required. Students majoring in Biopsychology can select a major advisor from either the Psychology or Biology department. Students graduating with a major in Biopsychology earn a B.S.

Major in Cognitive and Brain Sciences

This interdisciplinary major draws on psychology, neuroscience, linguistics, philosophy of the mind, computer science, and biology. Students are required to take a core of courses in psycholo-
ogy, a basic range of courses in the other constituent disciplines, and a series of upper-level courses in which they can specialize in one or more fields. Advanced students may choose to continue to be broadly interdisciplinary, or they may choose primarily to "track" within a single discipline such as psychology, philosophy, linguistics or computer science.

Beginning with the Class of 2019, this major consists of 14 courses, including the following 8 requirements: Intro to Psychology (PSY 1), Intro to Cognitive and Brain Sciences (PSY 9), Statistics (PSY 31), Experimental Psychology (PSY 32), Intro to Linguistics (Philosophy 16/Psychology 64), Intro to Computer Science (Computer Science 11), Data Structures (Computer Science 15), Psychology 195 as a senior.

Three intermediate courses are required, one from each of the following groups: Group A: Psychology 11, 25, 26, 27, 28, 29, 103, Child Development 51; Group B: Computer Science 131, 150BRR, 150CMCS, 150HRI, 150NLP, 171; Group C: Philosophy 3, 33 or 103, 191-02, Psychology 150, 151, 155.

Three advanced courses are required, drawn from at least two of the following groups (only 1 of which may be independent study/directed research): Group 1: Psychology 80, 91, 92, 103, 112, 117, 118, 121, 122, 123, 124, 126, 127, 129, 131, 139, 140, 142, 144, 145, 146, 148, 154, 191, 192, 199; Group 2: Psychology 149, 150, 151, 152, 153, 155, 158, 180; Child Development 145, 152, 155, 156, 177, 195, 250; Education 114; Group 3: Computer Science 86, 105, 131, 135, 150BRR, 150CMCS, 150HRI, 150NLP, 170, 171, 193, 194; Group 4: Philosophy 38, 114, 117, 126, 132, 133, 134, 170, 191-02 (note that for all four groups, courses may only be used if not counted as intermediate courses as described above).

Students in the Classes of 2018 or 2017 may follow the revised concentration requirements above. Or they may complete the older requirements, which do not include PSY 1 and instead call for four advanced courses drawn from at least two of the groups listed above.

Cognitive and Brain Science majors are encouraged to complete a senior research project which entails either (a) completing an honors thesis in Psychology, Child Development, Computer Science, or Philosophy; (b) completing a research experience with a faculty member in one of these departments or with a faculty member in the Neuroscience Department of the Medical School; or (c) completing a faculty-supervised review paper of the literature on a particular issue within one of these areas. Planning for such projects should begin by the end of junior year.

In addition, students are encouraged, after consultation with their advisor, to augment the Cognitive and Brain Science major by taking electives from Psychology (especially 37, 40, 41, 46, 48, 49, 107, 108), Anthropology (150), Biology (13, 14, 116, 134), and Math (11, 12, 13, 150). Students graduating with a major in Cognitive and Brain Sciences earn a B.S.

Major in Engineering Psychology
This interdisciplinary program, commonly called human factors engineering, is offered jointly by the departments of mechanical engineering and psychology. (See Engineering Psychology for program description and course listings.)

GRADUATE PROGRAM
The Department of Psychology offers both a master’s degree and a doctor of philosophy degree in general experimental psychology. To be considered for graduate work in psychology, a student must have a bachelor of arts or bachelor of science degree from an accredited college or university. Most students will have majored in psychology, but this is not a requirement. The student must, however, have had at least a one-semester course in statistics and at least six semester hours of experimental psychology or comparable research experience. Students having a master’s degree in psychology may apply for the doctoral program directly if their master’s degree included an empirical thesis.

Graduate students are expected to develop overall breadth in psychology, as well as an emphasis in a specialty area. Emphasis areas within the department include cognitive psychology; experimental psychopathology; physiological psychology and psychopharmacology; social psychology; cognitive, social, and affective neuroscience; and cognitive development. Considerable emphasis is placed on the student’s ability to undertake research. These skills are demonstrated in connection with course work, independent research, and the thesis and/or dissertation. All graduate students are expected to participate in supervised research each semester, as well as periodic teaching activities.
General Program Requirements

The program is based around five major annual milestones:

Year 1: A first-year project
Year 2: Completion of the master’s thesis
Year 3: Publication/grant submission
Year 4: Conceptual presentation at department conference and mini-review
Year 5: Completion of dissertation

There is no formal language requirement for either the master of science degree or the doctor of philosophy degree.

Master of Science

The requirements for the master of science degree include ten credits (eight course credits and two research credits) distributed as follows: completion of the graduate sequence in statistics (Psychology 107 and 108), one area core course, two upper-level psychology courses or seminars (100 level or higher), one additional 200-level core or seminar course, one independent reading/research course or other course credit, one professional preparation course, and successful completion of the first-year project (one credit) and the master’s thesis (one credit).

No more than two graduate-level courses, which have not been used to count toward another graduate degree, may be transferred from another institution toward the Tufts program.

The master’s thesis must be an empirical research study in psychology, which will be presented in written form and on which the candidate must take an oral comprehensive examination.

Students holding Tufts’ teaching and research assistantships are advised to register for five courses per year and should plan to spend more than one year in completing the degree. Only under exceptional circumstances should it require more than two years for completion. The department does not encourage part-time participation in the program.

Doctor of Philosophy

The doctor of philosophy degree requires thirteen credits (eight course credits, two research credits, and three dissertation credits) beyond those required for the master’s degree.

These must include one additional core course, two 200-level seminars, one additional professional preparation course, four elective courses or independent reading/research courses, a credit associated with completion of the third-year publication/grant submission, and a credit associated with the fourth-year conceptual presentation and mini-review. Additionally, when writing the dissertation, students must sign up for two 1.5 dissertation credits.

The doctoral candidate must submit a dissertation on his or her original empirical research and must take an oral examination in support of the dissertation.

In general, the student’s program of study is worked out with a faculty advisor, taking into account the student’s interests and background.

For more detailed information, please visit the website http://ase.tufts.edu/psychology.
Quantitative Economics

(FOR DEGREE REQUIREMENTS, SEE ECONOMICS.)
Religion

Professor Brian Hatcher, Chair; Hinduism and religion in modern South Asia
Associate Professor Heather Curtis, History of Christianity and American religions
Associate Professor Joseph Walser, Buddhism and religion in ancient South Asia
Associate Professor Kenneth Garden, Islam and Sufism
Assistant Professor Jennifer Eyl, Early Christianity and religions of the ancient Mediterranean

SECONDARY APPOINTMENTS:
Professor Gary Leupp, History; Japanese history and Japanese Buddhist studies
Associate Professor Kevin Dunn, English; Bible as literature
Assistant Professor Marie-Claire Beaulieu, Classics; Greek religion, epigraphy, medieval Latin

The Department of Religion is dedicated to the exploration and critical analysis of religion as a central aspect of human history and culture. Courses seek to promote reflection on the diversity of religious experience; empathetic engagement with a range of beliefs, texts and practices; mastery of a range of methods for studying religion; and reflection on the role religion plays in shaping human customs, values, beliefs, and institutions.

A graduate degree in religion is not offered. However, some 100-level courses may be taken in conjunction with other programs.

UNDERGRADUATE CONCENTRATION REQUIREMENTS

Major in Religion
Ten courses are required for the major in religion. These courses are to be distributed as follows:


b. Diversity requirement (four courses): Students should have exposure to at least four different religious traditions. This may be accomplished through classes in which four different traditions are taught, or through four courses, each focused on a different religious tradition, or through some combination thereof. Students are to take four classes within the department to achieve the diversity requirement. The advisor and the chair of the Department of Religion must approve the courses taken to fulfill this requirement.

c. Depth requirement (three courses): Students must choose a subfield in religious studies. This may be one religious tradition, the traditions of a geographical region, or a religious textual tradition. Students must demonstrate that they have taken at least three classes in that specialty. One of the three courses must be in the doctrinal (theological and philosophical) aspects of religion. In their chosen areas of specialization, students must take two above-100 level courses. These may include an independent study or a senior thesis. The departmental advisor and the chair must approve the student’s area of specialization. No course may count for both the diversity and depth requirements.

d. In addition to the above eight courses, two additional courses listed or cross-listed in religion, regardless of subject area, are required.

UNDERGRADUATE MINOR PROGRAM

Minor in Religion
Five courses, distributed as follows, are required.


b. Students should have exposure to at least three different religious traditions. This may be accomplished through classes in which three different traditions are taught, or through three courses, each focused on a different religious tradition, or through some combination thereof. The advisor and the chair of the Department of Religion must approve the courses taken to fulfill this requirement.

c. One other course numbered above 100. This course may not be counted as one of the three courses of the above requirement.
For more detailed information, please visit the website http://ase.tufts.edu/religion/.
The Romance languages all derive from the Latin spoken in different parts of the Roman Empire. Courses in French, Italian, Portuguese, and Spanish lead students to an understanding of the language when spoken or written, and allow them to read and appreciate each nation’s literature. At all stages of instruction, students may deepen their linguistic sensibilities and expand their horizons by studying, through a Romance language, a civilization different from but connected to their own. Students may major in French, Italian, or Spanish Studies, and may minor in Italian and Portuguese. A special minor for engineering students allows them to minor in French, Spanish, or Italian. The Department of Romance Languages also participates in the programs of the Experimental College.

LANGUAGE HOUSES
The Department of Romance Languages sponsors the French House and the Spanish House. The houses are open to all students interested in these languages and cultures and are not limited to majors. They offer small-group living and an opportunity to enjoy an intensive language experience, often with native speakers, and to participate in many social and cultural events.

JUNIOR YEAR ABROAD
Through the Tufts-in-Madrid, the Tufts-in-Paris, and the Tufts-in-Chile programs, the Department of Romance Languages offers undergraduate majors an unusual opportunity for study in Spain,
France, and Chile during the academic year. For more information, contact the Department of Romance Languages or the Office of Tufts Study Abroad.

Tufts-in-Paris Program
Preparation equivalent to completion of French 21 and 22 is prerequisite to the program; completion of one third-year level course, such as French 31 or 32 or French 121 or 122 is highly recommended. Students are registered in the University of Paris I (Panthéon-Sorbonne), the University of Paris III (Sorbonne Nouvelle), Sciences Po (Paris), and the private Institut Catholique and take most of their courses at these institutions. Courses are also offered within the Tufts-in-Paris program.

Internships are available to full-year students.

Tufts-in-Madrid Program
(See Tufts Programs Abroad for description.)
Preparation equivalent to completion of Spanish 21 and 22 is prerequisite to the program; completion of Spanish 31 and 32 or 34 are highly recommended. Students live in Madrid or Alcalá de Henares, and take classes within the Tufts-in-Madrid program, and at the Autonomous University of Madrid or the University of Alcalá. Internships available. For more information concerning the Tufts-in-Madrid Program, write to the Department of Romance Languages, the Office of Tufts Study Abroad, or see the program website at www.tufts-skidmore.es.

Tufts-in-Chile Program
(See Tufts Programs Abroad for description.)
Preparation equivalent to completion of Spanish 21 and 22 is prerequisite to the program; Students are registered in both universities; University of Chile and Catholic University. Fall registration takes place at University of Chile. Spring registration takes place at both universities.
For more information concerning the Tufts-in-Chile Program, write to the Department of Romance Languages or to the Office of Tufts Study Abroad.

Tufts University European Center
The Tufts University European Center sponsors a six-week summer study program in Talloires, on the Lac d’Annecy, in the heart of the French Alps. Students enroll for credit in two courses chosen from an array of offerings including French language, literature, and civilization. The courses, taught by members of the Tufts faculty, draw on the rich cultural and physical resources of this beautiful region of France. Classes are held in Le Prieuré (the Priory), which was formerly part of an eleventh-century Benedictine monastery. Each student lives and shares meals with a local French family; the residential component of the program adds an important dimension to the students’ experience of French daily life and culture. For more information, contact the Office of the Tufts University European Center.

Placement of Entering Undergraduates
All entering students who elect courses in French, Spanish, Italian, or Portuguese and who have previously studied the language will be placed in the appropriate course level by their scores on the SAT Subject Tests, Advanced Placement Test, or Tufts placement examination. The Tufts placement examination, which is for diagnostic purposes only, is given each September and January during the orientation period.

Students who place above French, Spanish, Italian, or Portuguese 3 may complete the language requirement by choosing any one of the three available options (see College of Liberal Arts Information, Foundation Requirements). One course credit equivalent to French/Spanish/Italian/Portuguese 21 or 22 is granted under certain conditions (see College of Liberal Arts Information, Advanced Placement and Acceleration Credit).

For further information, see the appropriate coordinator of language instruction.

Undergraduate Concentration Requirements in French and Spanish
Prospective majors in French or Spanish are advised to consult the guidelines for selecting a related field, which appear on the Romance Languages website. The department highly recommends that seniors returning from overseas programs enroll in two 100-level French or Spanish
courses on the Tufts campus during their final year of study. At least one of the four 100-level literature courses must be taken during the senior year on the Tufts campus itself.

**Major in French**
The French major requires ten courses as follows:
French 22, or equivalent; French 31 and 32, or equivalent; four 100-level courses in literature; two 100-level course to be selected from among the various course offerings in advanced language and culture, including French 121, 122, 124, 125, and all 100-level French courses unless specified otherwise, or their equivalents, or up to two additional 100-level courses in French literature; one course taught in any language in a related field, or one additional 100-level course in French language, culture, or literature. (Students participating in programs abroad may count toward the satisfaction of the latter two requirements a wide range of courses in language, literature, art history, geography, history, civilization, and other areas.) No more than one credit in Independent Study may be counted toward the major. No more than two credits combining an Independent Study and an honors thesis may be counted toward the major. All courses taken for credit in the major must be completed with a grade of C- or better.

**Major in Spanish**
The Spanish major requires ten courses as follows:
Spanish 22, or equivalent; two courses taught in Spanish in the introductory survey of literature sequence; three 100-level courses in literature; four 100-level courses to be selected from among the various course offerings in advanced language and culture, including Spanish 121 or 122, 124 or 125, 126, 130, 140, 148, 150, or their equivalents. One course may be in English. (Students participating in programs abroad may count toward the satisfaction of this requirement a wide range of courses in language, literature, art history, geography, history, civilization, and other areas, taught in the language of the major.) No more than one credit in Independent Study (SP 193 or 194) may be counted toward the major. No Independent Study can be taken during the senior year if the student is writing an honors thesis (SPN 199, two credits). All courses taken for credit in the major must be completed with a grade of C- or better.

**UNDERGRADUATE CONCENTRATION REQUIREMENTS IN ITALIAN STUDIES**
Prospective majors in Italian studies are advised to consult the list of courses exclusively devoted to Italian culture, taught in departments other than Romance Languages, which count toward the Italian Studies major. The list appears on the Romance Languages website. It is highly recommended that seniors returning from overseas programs enroll in an appropriate Italian course in the Department of Romance Languages during their final year of study. Interested students should consult the designated advisor for the major.

**Major in Italian Studies**
The Italian Studies major requires ten courses distributed as follows among Sections I, II, III, IV, and V:
Section I: Two courses in Composition and Conversation, taught in Italian, in the Department of Romance Languages: Italian 21 and 22, or equivalent;
Section II: Two survey courses of literature, taught in Italian: Italian 31, and 32, or equivalent;
Section III: One 100-level course of advanced Italian language, taught in Italian: Italian 121;
Section IV: Two literature or culture courses at the 100-level, taught in Italian;
Section V: Three elective courses in Italian literature, culture, or related fields, taught in Italian or English (see Guidelines, attached to the Checklist for the Major, for acceptable courses).

Courses taken in departments other than Romance Languages must be devoted exclusively to Italian culture (as attested by course description and syllabus), and must be approved by the Department of Romance Languages for credit in the major. No more than one credit in Independent Study may be counted toward the major. No more than two credits combining an Independent Study and an honors thesis may be counted toward the major. All courses taken for credit in the major must be completed with a grade of C- or better.
Minor in Italian
The minor in Italian requires five courses as follows:
Four courses in Italian language, literature, and/or culture above the intermediate level (Italian 3-4), one of which must be in literature. These courses must be taught in Italian. One course chosen from among the following: a) one further course in Italian language, literature, and/or culture, taught in Italian on the Medford/Somerville campus; b) a course in Italian literature or civilization taught in English translation (e.g., Italian 51, 52, 55, 75); c) one of the Italian culture courses listed in the Guidelines for acceptable courses; (d) an upper-level course, completed in Italy, in one of a variety of disciplines. No more than one credit in Independent Study may be counted toward the minor.

It is highly recommended that seniors returning from overseas programs enroll in an appropriate Italian course in the Department of Romance Languages during their final year of study.

Interested students should consult the designated advisor for the minor.

Minor in Portuguese
The minor in Portuguese requires six courses as follows:
Four courses in Portuguese language, literature, and/or culture above the intermediate level (Portuguese 3-4). Two courses chosen from among the following: a) Up to two more courses in Portuguese language, literature, and/or culture; b) Up to two courses of the Lusophone culture or civilization courses listed in the Guidelines for acceptable courses taught in English or Spanish; (c) One upper-level culture or literature course taught in Portuguese in a program abroad; (d) A second upper-level course taught in Portuguese and completed in a program abroad may be counted if approved by the minor coordinator. No more than one credit in Independent Study may be counted toward the minor.

It is highly recommended that seniors returning from overseas programs enroll in an appropriate Portuguese course in the Department of Romance Languages during their final year of study.

Interested students should consult the designated advisor for the minor.

Special Minors for Engineering Students
The humanities and/or arts and social sciences requirements for students in the School of Engineering may be satisfied by a special minor in French, Spanish, or Italian language and culture comprising a total of six credits. Please note the following stipulations:
1) Of the five credits taken in the Department of Romance Languages, no more than one credit may be taken in English.
2) Students must determine their level of proficiency in the language by examination (placement test at Tufts, Advanced Placement Test score, or SAT Subject Test score).
3) Students cannot receive credit toward the minor for courses taken below this initial placement.
4) Students must consult with the designated advisor for the special minor in the Department of Romance Languages.
5) Independent Studies will not be available.
6) All courses used in fulfillment of the minor must be taken for a grade.

FRENCH OR SPANISH
The minor requires five credits above French 3 or Spanish 3.

The sixth credit must be taken in the social sciences or the humanities, concentrating on the area in which the target language is spoken.

ITALIAN
The minor requires five credits above Italian 2.

The sixth credit must be taken in the social sciences or the humanities, concentrating on the area in which the target language is spoken.

DEPARTMENTAL HONORS
The departmental honors program provides the opportunity for majors in French, in Spanish, or in Italian Studies—in close cooperation with a faculty advisor—to write a senior honors thesis for one or two course credits. Each such credit may count toward the major as a 100-level literature
course. No more than two credits combining an Independent Study and an honors thesis may be counted toward the major. Near the end of the spring term, the thesis is defended before a committee of three readers, who determine whether the degree with highest honors in thesis, with high honors in thesis, or with honors in thesis is to be awarded at commencement. The applicant’s name must have appeared on the Dean’s List prior to the first term of the senior year. Interested students should consult with the potential advisor and with the chair of the department toward the end of the junior year.

GRADUATE PROGRAM

Master's Degree
A master of arts degree is offered in French language and literature. Preference is given to students who have a strong undergraduate major in French.

To qualify for the master’s degree, a student completes an approved program of at least ten courses, including a general examination. A student is expected to show evidence of scholarly attainment both in course work and in the general examination.

For more detailed information, please visit the website http://ase.tufts.edu/romiang.
Russian

(FOR DEGREE REQUIREMENTS, SEE GERMAN, RUSSIAN, AND ASIAN LANGUAGES AND LITERATURES.)
School Psychology

(FOR DEGREE REQUIREMENTS, SEE EDUCATION.)
Sociology

Professor Pawan Dhingra, Chair; Immigrant adaptation: Asian Americans; cultural identities: race and ethnic relations

Professor Paul Joseph, Sociology of war and peace, political sociology, globalization

Associate Professor Helen Marrow, Immigration, race and ethnic relations, social inequalities and social policies, health, qualitative research methods

Associate Professor Sarah Sobieraj, Mass media, political sociology, civil society and the public sphere, sociology of culture, social movements

Associate Professor Rosemary CR Taylor, Comparative historical study of health and disease; public policy; science, technology, and risk; qualitative methodology

Assistant Professor Orly Clerge, Race and ethnicity, urban sociology, immigration and migration, family, education, methods

Assistant Professor Freeden Oeur, Gender and masculinity; education; feminist theory; children and youth; culture

Assistant Professor Jill Weinberg, Crime; law; deviance; sports; the body; research methods

Sociology is the systematic study of social institutions, social inequalities, and social and cultural identities. Sociology studies how social structures shape human behaviors, social categories, and social meanings. Sociology also studies how behavior (agency) in turn constructs social structure. Institutions include media and culture, health and medicine, education, the military, organizations, urban environments, law, and more. Areas of study include group identities as well as social inequalities such as race, immigration, class, gender, and globalization. Sociology students learn how to critically examine and analyze social structure and culture; how social and cultural constructs such as gender, race, and class influence people’s lives; and how people change society by forming social movements and using the media.

UNDERGRADUATE CONCENTRATION REQUIREMENTS

Major in Sociology

All Sociology majors, including those who elect to do one of the four (4) clusters (see below), must complete ten (10) Sociology courses. None of the ten courses may be taken pass-fail, and at least six (6) of the courses must be listed or cross-listed by the Tufts University Department of Sociology. Three (3) courses must be the following core courses, at least two (2) of which must be taken in the Tufts University Department of Sociology:

001: Introduction to Sociology; and
100: Research Design and Interpretation; and
103: Survey of Social Theory.

Of the ten (10) required Sociology courses, one (1) must be a seminar numbered 180 or above. Sociology 193, 194, 197, 198 and 199 do not count for this requirement. Six (6) of the ten required courses are unrestricted electives, except for students who choose to complete a cluster.

Majoring in Sociology Using a Cluster Option

Students who major in Sociology may choose electives that complete one of the following cluster options:

1. Media, Culture, and Society
2. Social Inequalities and Social Change
4. Data Analysis and Interpretation
Minor in Sociology

The minor requires the completion of six courses, none of which may be taken pass-fail: one required introductory course numbered 1 through 70; one research methods course: (Sociology 100 or 101 or 102); one theory course: (Sociology 103); and three elective courses. Details are available from the department. Students should declare their minor by junior year.

For more detailed information, please visit the website http://as.tufts.edu/sociology
Spanish

(FOR DEGREE REQUIREMENTS, SEE ROMANCE LANGUAGES.)
The Department of Urban and Environmental Policy and Planning (UEP) offers two graduate public policy and planning programs culminating in either a Master of Arts (M.A.) degree or a Master of Public Policy (M.P.P.) degree, as well as an undergraduate Minor in Urban Studies. UEP also is a key participant in two interdisciplinary programs at Tufts: Environmental Studies Program and Water: Systems, Science and Society (WSSS) Program. Our goal is the education of a new generation of leaders, “practical visionaries,” who will contribute to the development of more just and sustainable communities. A key step toward this is making our institutions more responsive to child, adult, and ultimately community well-being by helping them understand, empathize with, and respond to the social, economic, and environmental needs of individuals and communities.

UNDEGRADUATE PROGRAM

Undergraduate Minor in Urban Studies
The Minor in Urban Studies provides students with an opportunity to pursue their love of cities and communities and to study urban issues in depth. Students can select from a variety of courses that examine the interplay among the different groups occupying the urban space, the problems they confront, their struggle for recognition and power, and the forces shaping the physical terrain they inhabit. The minor offers a good foundation for students contemplating graduate work in urban planning, environmental policy, public administration, public policy, law, or social work. It also can be an intellectually exciting focus for interdisciplinary exploration, because understanding urban phenomena requires synthesizing knowledge from a broad range of the social sciences and humanities. The completion of five courses from at least three different departments is required. In addition, a student is required to complete an appropriate capstone project, such as a research paper, an oral presentation, a video, a photographic exhibit, a fictional narrative, or other forms of study, which integrates the knowledge and methodologies of the disciplines involved. Interested students should contact the Department of Urban and Environmental Policy and Planning (uep@tufts.edu). For more detailed information, please visit: http://as.tufts.edu/uep/programs/minor.

AFFILIATED PROGRAMS

Environmental Studies Program
UEP actively engages with the undergraduate environmental studies program teaching a core course and participating in program governance and development. The program’s Sustainability, Policy, and Equity track is closely aligned with UEP, as is the Food Systems, Nutrition and the Environment track. Opportunities for UEP students include teaching assistant positions as well as collaborations with faculty and students in a wide variety of disciplines.
Water: Systems, Science and Society (WSSS) Program

All of the major graduate schools at Tufts University participate in the graduate certificate program in Water: Systems, Science and Society (WSSS), which is a model for integrative graduate education that organizes research and training on water policies and issues across disciplinary boundaries. MA/MS/PhD student participation in the program does not add time to their degrees and is done through their home department. The goals of this unique certificate program are to develop interdisciplinary research and practices that will make significant contributions, and to educate a diverse, ethical, skilled set of professionals who are trained in a multidisciplinary approach within a specialized degree.

UEP students enrolled in the WSSS certificate program select either the practicum track or the research track, and take either 2 or 3 WSSS-approved courses that also count toward the UEP degree. UEP faculty participate in all aspects of WSSS including teaching courses and serving on the WSSS Steering Committee.

GRADUATE PROGRAMS

UEP students focus on public problems in the broad areas of urban and social policy and planning, or environmental policy and planning, as well as on issues linking these various concerns. UEP’s goal is the education of a new generation of leaders, “practical visionaries” who will contribute to the development of more just and sustainable communities.

A key step toward this is making our institutions more responsive to child, adult and ultimately community well-being by helping them understand, empathize with and respond to the social, economic and environmental needs of individuals and communities.

We offer two graduate programs in public policy and planning: a Master of Arts (M.A.) degree in urban and environmental policy and planning that is accredited by the Planning Accreditation Board and a Master of Public Policy (M.P.P.) degree. Both degrees equip public-spirited individuals for rewarding careers in government, nonprofit organizations, citizen advocacy groups, and the private sector.

UEP has a flexible M.A. and M.P.P. curriculum built around a set of six core values:

1. An appreciation of the inextricable linkages between social, economic and environmental issues and the ability to make policy and planning recommendations accordingly.
2. An appreciation of the role of values in policy formation and planning and the ethical/social responsibility of policy and planning professionals to act accordingly.
3. An appreciation of the deeply embedded nature of gender, age, race, class, disability, culture and sexual orientation in all aspects of public policy and planning.
4. An appreciation of the centrality of spatial, social and environmental justice to all aspects of public policy and planning.
5. An appreciation of the need to understand the role of individual and community rights and responsibilities in public policy and planning.
6. An appreciation of the need to move society toward the development of sustainable communities where there is a high quality of human life, delivered in a just and equitable manner while respecting the limits of supporting ecosystems.

The M.A. also requires a set of competencies based on three areas:

Knowledge—Upon completion of the MA program, students should have basic familiarity with:

- The history, structure and function of urban and metropolitan settlements.
- Economic influences on policy and planning (e.g., “market” and “polis” relations).
- Environmental, social and cultural influences on policy and planning.
- The different roles of government, governance and citizenship in policy and planning.
- The history, theory and processes of both policy making and planning together with implementation procedures and practices.
- Evaluation of policy and planning.
- The administrative, legal and political aspects of policy and plan-making.
- Areas of specific policy or planning content-based knowledge related to their professional interest(s) and an in-depth knowledge of one policy or planning domain through the thesis or other terminal project.

Skills—Upon completion of the M.A. program, students should have basic skills in the following:
• Critical thinking skills
  o Individual problem identification and documentation of the extent of the problem as well as the political, social, environmental and spatial context
  o Identifying possible analysis strategies and their implications
  o Identifying criteria for proposing and selecting solutions
  o Evaluating the development and results of policies and plans
• Research skills
  o Research design
  o Literature collection and analysis
  o Identifying and assessing data sources and limitations
  o Development of data collection instruments and tools
• Data analysis skills
  o Interpreting and synthesizing data
  o Drawing inferences from specific observations to make more generalizable findings
  o Comparative and longitudinal analysis
  o Recognizing and accounting for limitations to findings
• Qualitative skills
  o Direct observation and analysis of primary and secondary qualitative data
• Quantitative skills
  o Descriptive and inferential statistics
  o Basic forecasting
  o Use of spreadsheets and statistical software
• Spatial analysis skills
  o Ability to identify spatial problems and frame spatial questions for analysis and research
  o Use of Geographic Information Systems for basic spatial analysis and mapping
• Communication skills
  o Written, oral and graphic communication
  o Presentation strategies and methods

Policy and Planning in Practice—The M.A. program will provide the following professional opportunities and training:
  • At least 150 hours, supervised, in an organization relevant to the student’s interests
  • Demonstration through the Internship Agreement and Learning Assessment that the internship gave the opportunity for significant learning in a field relevant to the student’s interests and meets at least one of his or her career goals
  • Reflections on the role of ethics in professional policy and planning processes, practices and behavior
  • Synthesis and application of policy and planning content-based knowledge from theory into practice
  • Collaborative group management, problem solving, negotiation and mediation
  • Organizational management, including decision making and strategic problem solving, human resource development, and financial management and resource development
  • Political and economic power mapping

Master of Arts
The Master of Arts (M.A.) requires completion of twelve or thirteen course credits plus a thesis or capstone exam for a total of fourteen credits. The program normally takes the equivalent of two years of full-time study, although it is possible to be enrolled in the program on a part-time basis.

Degree Requirements
The requirements for the M.A. degree are as follows:
  • Five required core courses covering theoretical foundations of policy and planning, and the development of relevant professional skills;
  • Seven or eight elective course credits approved by student’s advisor;
  • An internship in public policy or planning; and
  • A master’s thesis or capstone exam.

Students select courses from the department’s offerings, other Tufts departments and schools, and Boston-area consortium universities. To receive credit for a course, graduate students must attain a grade of B-
Core courses
A required core curriculum exposes students to methods of policy analysis and planning and helps them develop the competencies listed above, for effective professional practice.

The five required core courses are:
1. Foundations of Public Policy and Planning
2. Economics for Planning and Policy Analysis
3. Quantitative Reasoning for Policy and Planning (introductory or intermediate)
4. Field Projects: Planning and Practice
5. Cities in Space, Place and Time

Electives
In addition to the core curriculum, students choose courses that meet their particular objectives and provide a strong grounding in basic methods and approaches to public policy and planning. UEP recognizes the need for the policy and planning specialist, the person who wants to plan for landscape, ecological or watershed management, or develop child and/or family or other social welfare policies. However, UEP also recognizes the inextricable interconnections between and across different policy and planning areas, whether a student’s interest is primarily environmental or social, urban or rural, local or global. Accordingly, a student’s choice of classes can be narrower (on the public policy and planning challenges in one policy or planning area) or broader (on sustainable development, which looks at these issues and their interrelationships as a whole), depending ultimately on the student’s goals.

At UEP, faculty and student interests and course offerings center on the following:
- Sustainable communities
- Environmental and food justice
- Community development and housing
- Race, class, and social welfare policy
- Child and family policy
- Land use planning
- Natural resource policy and planning
- Science/technology, ethics, and environmental policy
- Environmental health and risk
- Corporate management of environmental Issues
- Climate change
- International urban and environmental policy
- Program evaluation
- Applied research methods
- Planning tools, techniques, and strategies
- Citizen roles in policy and planning
- Policy and planning for intercultural cities

Internship
An internship (minimum 150 hours) is usually completed between the two academic years. Most internships are based in a public or nonprofit agency, and are usually paid. Alternatively, students may elect a research internship, working on a university-based or research institution-based project. Although faculty provide assistance and advice, students are expected to secure their own internship placements.

Thesis
The thesis requirement provides students the opportunity to become proficient in framing a research question and carrying out an independent investigation on a topic of the student’s choosing. Building on competencies developed through course work, students present a well-reasoned analysis of a significant policy or planning problem. Theses may be technical studies, policy analyses, theoretical papers, research studies, or planning reports.
Capstone exam
The capstone exam requirement represents a topic-based assessment of an individual student’s interests in the fields of policy and planning. The student chooses major and minor topics in collaboration with a faculty advisor and reader(s) in a fashion similar to the selection of a thesis topic. There are three separate components to the capstone exam: (1) a detailed literature review; (2) a take-home exam; and (3) an oral exam.

Master of Public Policy
The Master of Public Policy (M.P.P.) is for individuals with at least seven years of significant, relevant professional experience, who are interested in expanding their knowledge of public policy within urban, social, and environmental domains—or across these domains, such as programs and policies related to sustainable communities.

This degree program offers students the opportunity to strengthen their critical thinking, policy analysis, and communication skills; improve their professional practice in areas such as mediation, land use planning, or financial management; and establish close professional relationships and networks among faculty, affiliated agencies, and other students. Full-time students may complete this nine-credit degree in one year; part-time enrollment options are also available.

Degree Requirements
• Four required core courses that enable students to reflect on their professional practice, examine dominant theories and themes in the public policy literature, and further refine and consolidate their perspectives on their career paths.
• Four elective courses in a public policy area.
• Two additional elective courses in policy and planning fields or professional skills.

The four core courses are:
1. Economics for Planning and Policy Analysis
2. Quantitative Reasoning for Policy and Planning (introductory or intermediate)
3. Reflections on Public Policy Practice (one-half credit, fall, in the first semester of student’s program)
4. Integrative Seminar (one-half credit, spring, in the last semester of the student’s program)

An M.P.P. seminar is composed of the two half-credit courses. It helps students examine their own professional experiences in the context of prevailing theories about policy and program development, implementation, and evaluation. The M.P.P. seminar is for M.P.P. degree students only. All other courses are taken with students in the M.A. in urban and environmental policy and planning program. Up to two courses may be selected from course offerings in other Tufts departments and schools, as long as they relate to public policy and are approved by the student’s advisor. In addition, with the advisor’s approval, one class at a consortium school may be taken in the second semester. Transfer credits will not be accepted. Students with significant background in economics or statistics may, with faculty approval, waive the relevant required courses and substitute electives of their choosing.

Public Policy Areas
Each student, working closely with his or her academic advisor, identifies an area of public policy interest(s). The student then selects four policy courses that deepen his/her theoretical and practical understanding of policy within this area(s) of interest.

All our courses focus on urban, social and/or environmental policy issues. A student can choose from one or more of these areas, or can choose to focus on the intersection(s) between these areas, namely the arena of sustainable development.

Examples of Public Policy Courses
• U.S. Social Welfare Policy
• Social Policy for Children and Families
• Community Development, Planning and Politics
• Community Economic Development
• Climate Change Policy, Planning and Action
• Environmental Law
• Water Resources Policy and Planning and Watershed Management
• Corporate Management of Environmental Issues
Developing Sustainable Communities
• Environmental Justice, Security and Sustainability
• International Planning and Urban Policy

Professional Practice Electives
Students also have opportunities to enroll in courses that enhance their professional practice skills, such as:
• Leadership and Organizational Development
• Financial Analysis and Management
• Philanthropy and Fundraising
• Negotiation, Mediation, and Conflict Resolution
• Program Evaluation
• Local Government Finance

Inquiries and requests for application materials for either the M.A. or M.P.P. degree program should be addressed to the Department of Urban and Environmental Policy and Planning, 97 Talbot Avenue, Tufts University, Medford, Massachusetts 02155, or call 617-627-3394. The application deadline for the M.A. program is January 15; the application deadline for international applicants is December 31; the deadline for the M.P.P. program is January 15 (all applicants) and April 30 (domestic applicants only). Late applications may be considered.

Interdisciplinary Doctorate
The department participates in Tufts’ interdisciplinary doctoral program, which accepts a limited number of Ph.D. candidates (applicants must have completed a master’s degree) who design an individualized program of study. (See Interdisciplinary Doctorate in this bulletin for program description.)

Combined Bachelor’s/M.A. Degrees Program
The Combined Bachelor's/Master's Degrees Program is offered by the College of Liberal Arts and the Graduate School of Arts and Sciences and is administrated by UEP. Exceptional students may combine undergraduate and graduate courses and are simultaneously enrolled in the bachelor's and master's degrees. Both degrees are awarded only on completion of the entire program; a student may not receive one degree earlier, even if the requirements for that degree have been met. It is expected that the student will complete the Combined Bachelor's/Master's Degrees Program in five years.

The Program is open to all majors offered in the College of Liberal Arts. Potential related majors include (but not limited to) anthropology, architectural studies, biology, community health, economics, environmental studies, sociology, and political science. The relevant master's degree is the Master of Arts (M.A.) in Urban and Environment Policy and Planning, which requires two years of full-time study ordinarily for a total of 14 credits.

Students seeking admission to the Program should consult their undergraduate major advisors and UEP student affairs coordinator before applying. Combined-degrees students are expected to fulfill all the requirements of the undergraduate and graduate programs. No courses offered in fulfillment of one set of requirements may be used for the other. A student may elect to withdraw from the Program at any time by filing the appropriate petition.

Joint and Dual Degree Programs
UEP offers joint master’s degree programs with the Departments of Biology, Child Study and Human Development, Civil and Environmental Engineering, and Economics. Students complete core requirements in UEP and one of the affiliated departments to receive a single master’s degree (M.A. or M.S.). It is possible to complete joint degree requirements in two years. UEP also offers dual degree programs with the Fletcher School, Department of Civil and Environmental Engineering in the School of Engineering, Friedman School of Nutrition Science and Policy, Department of Public Health and Community Medicine in the School of Medicine, Boston College Law School, and Boston College Carroll School of Management.

For the dual degree programs, each department/school reviews candidates based on its own requirements and criteria. The candidate’s admission to UEP is not affected by that of the other department/school, and vice versa. Students are required to meet with academic advisors from both UEP and the other department/school to plan a course of study that balances each student’s background and interests with the requirements of the specific program.
Please note: these programs are not available to students in the M.P.P. program.

**UEP and Biology**
The joint master’s degree in UEP/biology responds to the need for biological literacy by professionals working in policy areas. The program is designed for individuals who are interested in understanding the technical side of policy and planning, including the implementation of policy (e.g., regulations) and the formulation of policy (e.g., legislation), and accounting for biological aspects of land-use issues (e.g., working with governmental and nongovernmental conservation and planning organizations). Students have the choice of receiving the M.A. or M.S. degree.

**UEP and Child Study and Human Development**
UEP and the Eliot-Pearson Department of Child Study and Human Development offer a joint master’s degree program in child and family policy. The degree is designed for individuals interested in child and family program development, program evaluation, public and private agency administration and planning, policy-oriented research, child advocacy, and community organizing around child and family issues.

**UEP and Civil and Environmental Engineering**
UEP students may pursue either a joint or dual degree program with the Department of Civil and Environmental Engineering in the School of Engineering. Both programs respond to the need for environmental professionals who are skilled in both a technical and policy perspective in the analysis, planning, and implementation of environmental management and health activities. The programs combine policy study skills with more technical training in civil and environmental engineering. The joint degree program results in an M.S. degree, while the dual degree program results in both the M.A. and M.S. degrees. The former requires twelve course credits, plus a thesis, while the latter requires seventeen course credits, plus a thesis, and can be completed in five semesters.

**UEP and Economics**
Economics and public policy and planning are inextricably intertwined. Public policy issues have motivated some of the classic studies in economics, and the tools of economic analysis can be applied to a wide variety of policy and planning questions. The joint-degree program between UEP and the Department of Economics provides students with an opportunity to explore these long-standing linkages and to develop skills in policy analysis and planning based in economics. A student who completes the program is awarded a joint M.S. degree.

**UEP and the Fletcher School**
The Fletcher School offers a broad program of professional education in international affairs. Its curriculum addresses international law and organization, diplomatic history and international political relations, international economic relations, and international political institutions and systems. UEP and the Fletcher School offer a dual degree program focusing on international environmental policy. This program provides an opportunity for a limited number of highly qualified students to earn both the M.A. degree in urban and environmental policy and planning and the Master of Arts in law and diplomacy (M.A.L.D.) at the Fletcher School. By combining the two programs, the dual degree can be completed in three instead of four years. The dual degree program responds to growing student and professional demand for graduate education in international environmental policy. It is designed to prepare students for careers in economic and development institutions, government agencies, and nonprofit organizations concerned with international problems affecting the physical environment, such as acid rain, offshore oil drilling, soil erosion, deforestation, biodiversity, waterways pollution, and chemical contamination.

**UEP and the Friedman School of Nutrition Science and Policy**
The dual degree programs with the Agriculture, Food, and Environment (AFE) program and the Food Policy and Applied Nutrition (FPAN) program of the Gerald J. and Dorothy R. Friedman School of Nutrition Science and Policy are meant for students interested in the connection between environmental effects of food production and supply, and who want to become active participants in policy and planning debates. Students pursuing these programs are interested in deepening their knowledge of policy analysis and planning, and understanding how food policy fits into larger public policy and planning issues—including environmental problem solving and community development. By combining two programs, the dual degree can be completed in three instead of four years. Students receive both an M.A. degree in urban and environmental poli-
and planning and an M.S. degree in agriculture, food, and environment or an M.S. degree in food policy and applied nutrition.

**UEP and Public Health and Community Medicine**

Increasingly, public health, community planning and environmental policy have become integrated in the field. A student completing this dual degree program earns an M.P.H. (master of public health) degree from the School of Medicine and an M.A. degree in urban and environmental policy and planning. The program generally requires six semesters of full-time study. Students enroll in three semesters at UEP and three semesters (including summers) at the M.P.H. program. The preferred sequence of enrollment is for students to enroll in UEP for their first and second semesters. The student then enrolls in the M.P.H. program in their third and fourth semesters, and splits their final year between UEP and M.P.H. enrollment. Students are encouraged to integrate their knowledge in both programs from the start, as those enrolled in either program may take courses to fulfill degree requirements via cross registration.

**UEP and the Boston College Law School**

This program is for students interested in exploring the connections between the law and urban and environmental policy and planning. Students receive two degrees—an M.A. and a Juris Doctor (M.A./J.D.). The dual degree program recognizes that the fields of law and planning are inexorably linked. Planning (including policy analysis) is a process of guiding future developmental patterns; the law frames the mechanisms and limits of governments’ control over this process. Planning and law immerse students in broad debates and critical thinking about the environment, human settlements, social and environmental justice, corporate responsibility, and land use. All of these issues are guided by constitutional, equitable, and pragmatic principles.

The M.A./J.D. is offered through collaboration between UEP and the Boston College Law School. There is currently no graduate program in New England which offers the combined strengths of this dual degree program.

During their first year, students choose to take courses either through UEP or the law school exclusively. Students split their courses between the department and the law school in the years that follow. Students may transfer credits toward each degree, allowing them to concentrate their studies and complete the program in four years (as opposed to five, which would be typical if a student were pursuing each degree separately). For detailed information on the requirements for the J.D., please contact the Boston College Law School, Newton, MA 02459, or visit [www.bc.edu/schools/law/home.html](http://www.bc.edu/schools/law/home.html).

**UEP and the Boston College Carroll School of Management**

This program is designed for students who want to develop leadership and management skills to implement policy and planning initiatives, and those interested in social entrepreneurship, corporate social responsibility and sustainability. Students receive two degrees—a Master of Arts and a Master of Business Administration (M.A./M.B.A.). The dual degree recognizes that the fields of planning, policy and management have always been linked, but the value of the nexus increases with a complex global economy and growing world population. Planning, policy and management disciplines have embedded in them broad debates and critical thinking about the environment, human settlements, social and environmental justice, corporate responsibility, sustainable communities, and land use, each guided by core values, accountability and professional practice. The values-driven nature of both programs means that in scholarship and practice, faculty and students in the dual program actively negotiate the evolving relationship between business and civil society.

The M.A./M.B.A. program, offered through collaboration between UEP and Boston College’s Carroll School of Management (CSOM), is unique, offering students the opportunity to capitalize on the strengths of two nationally recognized schools. During their first year, students choose to take courses either through UEP or CSOM exclusively. Students split their coursework between UEP and CSOM in the years that follow, ultimately spending three semesters registered at CSOM and three semesters registered at UEP. For detailed information on requirements for the M.B.A., please see [www.bc.edu/content/bc/schools/csom/graduate.html](http://www.bc.edu/content/bc/schools/csom/graduate.html).

**CERTIFICATE PROGRAMS**

In addition to the master’s programs, UEP offers two certificate programs in community sustainability. The certificates in management of community organizations and community environmental studies emphasize participatory strategies for community self-determination and sustainability. These flexible programs enable working adults to gain the vital management and environmental skills necessary to enhance current careers.
or to move into new professional work. A third certificate in program evaluation is offered in collaboration with the Department of Child Study and Human Development, the Gerald J. and Dorothy R. Friedman School of Nutrition Science and Policy, and the School of Medicine.

To earn a certificate, students successfully complete four courses for credit. The certificate in program evaluation also requires completion of an applied practicum. Courses for the certificate programs are drawn from the curriculum of the M.A. program. It is possible to complete a certificate program in as little as one year or to extend it over several years. The certificate programs are open to students with a bachelor’s degree. For more information, visit [http://gradstudy.tufts.edu](http://gradstudy.tufts.edu).

**Certificate Program in Community Environmental Studies**

The certificate in community environmental studies (CES) provides professional training for careers in today’s rapidly growing and changing environmental field. The program offers a rich and varied selection of environmental courses in planning, policy, economics, engineering, and science complemented by courses in negotiation, law, and nonprofit management. This program is designed for citizen advocates seeking to promote environmentally sustainable communities, environmental specialists in companies who interact with community leaders, and public agency personnel. (See Community Environmental Studies in this bulletin for description.)

This certificate requires four courses.

**CES Core Courses**

Select at least one core course from the following:

- **UEP 200** Land Use Planning I: Nonregulatory Tools and Techniques (Fall)
- **UEP 201** Land Use Planning II (Spring)
- **UEP 221** Climate Change Policy and Planning (Spring)
- **UEP 223** Fundamentals of U.S. Agriculture (Fall)
- **UEP 279** Water Resources Policy, Planning, and Watershed Management (Fall)

**CES Electives**

Select up to three skills and environmental policy electives from the following:

- **UEP 161B** Writing and Public Communication
- **UEP 173** Transportation Planning
- **UEP 205** Urban Planning and Design
- **UEP 206** Planning for Low Impact Development
- **UEP 230** Negotiation, Mediation, and Conflict Resolution
- **UEP 232** Introduction to Geographic Information Systems
- **UEP 233** Regional Planning: Tools and Techniques
- **UEP 234** Qualitative Analysis for Planning and Public Policy
- **UEP 242** International Planning and Urban Policy
- **UEP 264** Green Urban Design
- **UEP 265** Corporate Management of Environmental Issues
- **UEP 278** Environmental Justice, Security, and Sustainability
- **UEP 284** Developing Sustainable Communities
- **UEP 286** Environmental Ethics
- **UEP 294-16** Special Topics: Public Health and the Built Environment

(Students may substitute other Tufts graduate courses, subject to the approval of the certificate advisor.)

**Certificate Program in Management of Community Organizations**

The certificate in management of community organizations (MCO) offers professional management training within the framework of the social, economic, and political values that shape the nonprofit sector. The program’s goal is to train people in effective management who are committed to social policy and wish to work at the community level. Participants share a commitment to working to improve the housing, employment, environment, health, and overall quality of life for low-income groups and communities. (See Management of Community Organizations in this bulletin for description.)
This certificate requires four courses.

**MCO Core Courses**
Select at least one core course from the following:
- UEP 253 Financial Analysis and Management (Spring)
- UEP 256 Program Evaluation (Fall and Spring)
- UEP 261 Community Development, Planning, and Politics (Spring)
- UEP 276 Leadership and Organizational Development (Fall)

**MCO Electives**
Select up to three skills and urban and social policy electives from the following:
- UEP 161A Writing and Public Communication
- UEP 205 Urban Planning and Design
- UEP 213 Housing Policy
- UEP 230 Negotiation, Mediation, and Conflict Resolution
- UEP 240 U.S. Social Welfare Policy
- UEP 251 Economics for Planning and Policy Analysis
- UEP 271 Community Economic Development
- UEP 275 Policy Implementation and Innovation
- UEP 282 Social Policy for Children and Families
- UEP 284 Developing Sustainable Communities
- UEP 294 Local Government Finance

(Students may substitute other Tufts graduate courses, subject to the approval of the certificate advisor.)

**Certificate Program in Program Evaluation**
Private funders and public agencies are increasingly demanding evaluation as a provision for funding. Individuals with evaluation training are needed to assist programs, sponsoring agencies, and funders in planning and carrying out evaluations to address their needs for information and analysis. The certificate in program evaluation is designed for midcareer professionals who wish to learn about the design and implementation of effective evaluation strategies. Students learn practical skills that can be put to use in the evaluation of a wide range of social service, public health, community development, and environmental programs. In addition to a bachelor’s degree, applicants are expected to have three to five years of professional experience in a particular field. (See Program Evaluation in this bulletin for description.)

This certificate requires four courses (format code: UEP = Urban and Environmental Policy and Planning; CD = Child Study and Human Development; PSY = Psychology; NUTR = Nutrition; SOC = Sociology; OTS = Occupational Therapy; ED = Education; MPH = Public Health).

Courses in statistics, data analysis, and research methods are offered by several departments. Course substitutions can be made with the approval of the certificate faculty advisor.

1. Foundation course:
   - UEP 256 (also CD 247) Program Evaluation

2. One course in applied statistics and data analysis, for example:
   - CD 140 Problems of Research: Statistics
   - MPH 205 Principles of Biostatistics
   - NUTR 209 Statistical Methods for Nutrition Research
   - NUTR 211 Nutrition Data Analysis
   - PSY 107/108 Advanced Statistics
   - SOC 101 Quantitative Research Methods
   - UEP 254 Quantitative Reasoning for Policy and Planning

3. One course in research methods, for example:
CD 142 Problems of Research: Methods and Design
ED 271 Methods of Educational Research
MPH 201 Principles of Epidemiology
NUTR 210 Survey Research in Nutrition
OTS 210 Research Methods
SOC 105 Field Research

4. One elective in your area of interest or expertise: education, child development, nonprofit management, social or environmental policy, nutrition, or public health.

For more detailed information, please visit the UEP website http://as.tufts.edu/uep.
The Minor in Urban Studies provides students with an opportunity to pursue their love of cities and communities and to study urban issues in depth. Students can select from a variety of courses that examine the interplay among the different groups occupying the urban space, the problems they confront, their struggle for recognition and power, and the forces shaping the physical terrain they inhabit. The minor offers a good foundation for students contemplating graduate work in urban planning, environmental policy, public administration, public policy, law, or social work. It also can be an intellectually exciting focus for interdisciplinary exploration, because understanding urban phenomena requires synthesizing knowledge from a broad range of the social sciences and humanities. The completion of five courses from at least three different departments is required. In addition, a student is required to complete an appropriate capstone project, such as a research paper, an oral presentation, a video, a photographic exhibit, a fictional narrative, or other forms of study, which integrates the knowledge and methodologies of the disciplines involved. Interested students should contact the Department of Urban and Environmental Policy and Planning (uep@tufts.edu). For more detailed information, please visit: http://as.tufts.edu/uep/programs/minor.
Women’s, Gender, and Sexuality Studies

DIRECTOR:
Associate Professor Sarah Pinto, Anthropology/WGSS

PROGRAM ADMINISTRATOR:
Andrea Carlino

AFFILIATED FACULTY:
More than fifty faculty members across Arts and Sciences are affiliated with WGSS as teaching faculty and/or mentors for senior projects. For an updated list and information about affiliated faculty please see the program website: http://ase.tufts.edu/wgss.

Women’s, Gender, and Sexuality Studies is an interdisciplinary program that focuses on research and teaching in three overlapping fields of inquiry. Scholarship in Women’s, Gender, and Sexuality Studies integrates knowledge and methodologies from many disciplines to analyze the various historical and political circumstances, social and economic forces, and cultural representations that shape gendered lives. It emphasizes the fundamental intersection of gender and sexuality with other crucial categories of human identity and experience, including race, ethnicity, and class. It explores the connections between the individual and institutional systems of power in local, national, and transnational contexts. It draws on the insights of feminist theory and practice and develops new modes of critical thought and new models for activism. The program offers a number of interdisciplinary courses, including introductory courses and special topics courses open to all undergraduates; in addition, it brings together a wide range of courses taught in different departments and programs, each contributing a unique approach to specific topics and materials within the broad and diverse study of women, gender, and sexuality. Additionally the WGSS program organizes lectures, faculty research colloquia, and other academic events, including annual public forums in which students present their research and capstone projects.

UNDERGRADUATE MAJOR Requirements
The major in Women’s, Gender, and Sexuality Studies gives students the opportunity to pursue their own intellectual interests within the multi-faceted study of women, gender, and/or sexuality. All majors take two interdisciplinary courses offered by the Program (WGSS 72: Intro to WGSS and WGSS 190: Doing Feminist Research); two core courses that explore the broad, foundational questions and arguments within specific disciplines or interdisciplinary fields of study; and five electives chosen from at least three different departments or programs that engage particular subjects, issues, and materials in the study of women, gender, and/or sexuality. Among the five electives, students take at least three within a concentration area chosen from those suggested on the program website or designed individually in consultation with the program director based on a student’s focus of interest. In addition, all majors do a capstone project in the senior year that develops from the concentration area, either as a mentored independent project (WGSS 193) or, if eligible, an honors thesis (WGSS 198/199). The director of WGSS serves as academic advisor to the major and oversees the progress of all students in the program. Two faculty mentors from different disciplines appropriate to the topic advise on the capstone project or thesis in the senior year. With the director’s approval, one internship for credit, one Experimental College course, and one independent research course may count as electives. All courses must be taken for a letter grade and receive a grade of C- or higher. With approval from the director, up to four credits can be transferred from another institution towards the major.

UNDERGRADUATE MINOR Requirements
The WGSS interdisciplinary minor complements and may also integrate with a student’s major. Students pursuing the minor in Women’s, Gender, and Sexuality Studies take a total of six credits, including two interdisciplinary courses offered by the program (WGSS 72: Intro to WGSS and WGSS 190: Doing Feminist Research) and three electives from at least two different departments or programs that engage particular subjects, issues, and materials in the study of women, gender, and/or sexuality. It is recommended that one core course be included among the electives. In addition, all minors do a capstone project in the senior year, either as a mentored independent project (WGSS 193) or, with approval from the program director, by doing a substantial research paper/project in a fourth WGSS elective course. The director advises on course selection to fit each student’s interests and to identify a framework for the capstone project. Two faculty mentors from different disciplines appropriate to the topic advise on the capstone project in the senior year. If com-
pleted by doing a substantial research paper/project in a fourth WGSS elective, the instructor of the course acts as mentor and grades the paper, a copy of which must be delivered to the WGSS office to fulfill the capstone requirement. All courses must be taken for a letter grade and receive a grade of C- or higher. With approval from the director, two credits can be transferred from another institution towards the minor.

GRADUATE COURSES
Tufts is one of the nine institutional members of the Graduate Consortium in Women’s Studies (GCWS), which offers a changing curriculum of interdisciplinary, team-taught graduate level courses for credit toward a Tufts graduate degree (with departmental advisor approval). Undergraduates doing research in a relevant topic can apply to be admitted to a GCWS course. The courses have a Tufts registration number. For more information about specific courses, the application process, and other Consortium programs for graduate students, including conferences, a dissertation writing workshop, and the annual Mother Board writing prize, contact the Consortium at 617-642-3485 or visit http://mit.edu/gcws.

WGSS CURRICULUM
Women’s, Gender, and Sexuality Studies lists at least twenty courses each semester in a wide range of subjects and materials offered by departments and programs, including those taught regularly and as special topics within the WGSS Program. See the Program website at http://ase.tufts.edu/wgss for specific semester listings, course descriptions, and other information about the Women’s, Gender, and Sexuality Studies requirements and curriculum.
Tufts makes available a wide range of courses on foreign literatures in English translation, Anglophone literatures abroad, diaspora literatures and other cross-cultural literary surveys, as well as introductory survey courses of foreign literatures in the original languages. For a full list of such courses, see the information about International Literary and Visual Studies (ILVS) at the following site: [http://ase.tufts.edu/ILVS](http://ase.tufts.edu/ILVS), and the course offerings of the various foreign language and literature departments: Classics (which comprises Greek and Latin); Drama; German, Russian, and Asian Languages and Literatures (which comprises Arabic, Chinese, German, Hebrew, Japanese, Judaic Studies, and Russian); and Romance Languages (which comprises French, Italian, Portuguese, and Spanish). The nearest equivalent to a major in World Literature is the major in ILVS. Please see the description of that major at the site referred to above. The Department of English and the Department of Drama and Dance also offer majors with a broadly international and cross-cultural orientation. See those departmental websites for details.