THE BIOMEDICAL ENGINEERING GRADUATE PROGRAM HANDBOOK

UNIVERSITY OF CONNECTICUT
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The information in this handbook is to supplement the University of Connecticut Graduate catalog available at: http://catalog.grad.uconn.edu/grad_catalog.html.

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FOREWORD

This handbook provides an introduction and some information for students and faculty in the Biomedical Engineering Graduate Program at the University of Connecticut. It is meant to supplement the University of Connecticut Graduate Catalog (which can be found at http://catalog.grad.uconn.edu/grad_catalog.html) and provides additional background information on biomedical engineering, the application procedure, the curriculum, the faculty, assistantships, fees and financial aid, and course descriptions. The University of Connecticut also offers an undergraduate Biomedical Engineering BS degree with specialized fields of study in: Bioinformatics, Biosystems, Imaging & Instrumentation, Biomaterials, and Biomechanics. The Biomedical Engineering program offers M.S. and Ph.D. degrees in Biomedical Engineering, and also participates in the UCHC Medical Scientist Training Program.

Biomedical engineering involves learning about biology in new ways and developing new tools to diagnose disease and to repair or replace diseased organs. Many students select biomedical engineering to be of service to people and for the excitement of working in a health field. Additionally, biomedical engineering provides excellent preparation for entrance into medical school with either the Biomedical Engineering BS or MS degrees. At many schools, there are as many women studying biomedical engineering as men. Biomedical engineers work with other medical health care professionals as members of a team. Exciting advances in medicine, such as the artificial heart, pacemakers, medical imaging techniques, prosthetic implants, life support systems, and devices that help the paralyzed walk, are oftentimes the result of a team effort by biomedical engineers and other professionals. Biomedical engineering activities at the University of Connecticut have a rich 40+ year history of success and accomplishment. The main campus of the University of Connecticut educates nearly 25,000 students within facilities that include 120 major buildings on 3100 acres in Storrs, CT. The University of Connecticut is in the midst of a $2.3 billion program to renovate the campus, and add new buildings and facilities. The Biomedical Engineering Program is located at the main campus in Storrs (20 miles east of Hartford and 35 miles north of New London) and at the Health Center in Farmington (approximately 10 miles west of Hartford). Diversity and excellence, hallmarks of the academic program, describe the cultural life of the University. Students may be participants or spectators in a full roster of campus events. The Biomedical Engineering faculty and their current research interests are described at our website, http://www.bme.uconn.edu/faculty.php The participation of faculty members who are leaders in their fields with extensive government and industry sponsored research programs, along with excellent research and educational facilities, creates an ideal environment for studying Biomedical Engineering at the University of Connecticut.

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INTRODUCTION

Biomedical Engineering

Biomedical engineering is a profession involving engineering and the life sciences, physical sciences and medical science to understand problems in physiology and biology and improve human health.

The goal of the Biomedical Engineering Graduate Program is to provide students the interdisciplinary training in biological and medical sciences, physical sciences, and engineering necessary to solve complex biomedical problems. Faculty members from engineering, biomedical sciences, materials sciences, chemistry, physics, medicine, and dental medicine form an interdisciplinary graduate degree program that spans the University of Connecticut campuses at Storrs and at the Health Center (UCHC) in Farmington.

Biomedical engineering can embrace the following diverse yet complementary research areas: biochemical engineering, bioinformatics, bioinstrumentation, biomaterials, biomechanics, biomedical imaging/biosignal processing, biosensors, biotechnology, cellular and tissue engineering, clinical engineering, ergonomics, medical informatics, physiological systems modeling, and rehabilitation engineering. An entering student's primary undergraduate training may be in engineering, the physical sciences, medicine or biology. However, all students must demonstrate competence in mathematical analytical methods, certain basic and advanced skills in engineering and computer science, as well as knowledge of core fundamentals of biomedical engineering at the time of their graduation. Plans of study are developed in consultation with the student's advisory committee and are designed to meet individual needs and program requirements.

Examples of work done by biomedical engineers include:

- Designing and constructing cardiac pacemakers, defibrillators, artificial kidneys, blood oxygenators, hearts, joints, arms, and other prosthetic devices.
- Designing computer systems that monitor the various systems of the human body, i.e. EKG monitors.
- Designing instruments for therapeutic uses, e.g. lasers for eye surgery, automatic drug delivery systems.
- Constructing mathematical models of physiologic systems, e.g. the cardiovascular system.
- Applying the principles of biomechanics to injury, wound healing, gait analysis, etc.
- Maintaining, managing, and teaching engineering technology in the hospital environment in support of the correct use of medical equipment.

The Clinical Engineering Internship Program

Clinical engineering is the application of engineering methods and technology to the delivery of health care. The clinical engineer is a member of the health care team responsible for the management of medical technology in the hospital environment. The tasks that a clinical engineer provides include supervising a clinical engineering department, designing or modifying sophisticated medical instruments, evaluating new medical equipment for purchase, integrating medical equipment into existing systems and networks, repairing equipment, testing the safety of equipment, asset management, vendor service management, projects (i.e., R&D, re-engineering, new system implementations), regulatory support (i.e., JCAHO [Joint Commission for the Accreditation of Healthcare Organizations], CAP [College of American Pathologists]), and instructing clinicians (physicians & nurses) in the proper use of medical equipment. The Clinical Engineering internship program offers an in-depth, rigorous, clinical experience that matches the engineering expertise gained in the classroom. The primary objectives of this intense internship program are as follows:

- Provide exposure to hospital organization and administrative functions.
- Permit hospital experience in clinical engineering; that is, provide an opportunity to apply engineering techniques to patient care and hospital-based research.
- Provide substantial experience working with hospital personnel, including administrators, nurses, technicians, and medical staff.
- Provide a better understanding of the environment in which modern medical systems and devices are used to assist in the delivery of patient care.
- Understand the risks and safety issues associated with the use of medical equipment in the hospital

These objectives are not traditional classroom experiences; rather, they emphasize the practical side of health care technology. They are achieved not only by observing, but also by actually working on projects in the clinical environment. Because the program requires that the intern spend the entire two academic years working approximately twenty (20) hours per week at the hospital with the remaining time concentrated in classroom activities, there is ample time for the student to be thoroughly indoctrinated into hospital operation and procedures and to select those courses most helpful to them as they profit from experience in the clinical environment.

The medical institutions that are currently participating in the program include:

- The University of Connecticut Health Center – John Dempsey Hospital
- Hartford Hospital
- Baystate Health System
- VA Connecticut Healthcare System (West Haven)
- University of Massachusetts Memorial Medical Center (Worcester)
- Providence VA Medical Center
- VA Boston Healchcare System
- Lifespan Health System (Providence)
- Middlesex Hospital
- Brigham & Women's Hospital
- LINC/ABM Health Incorporated
- Massachusetts General Hospital
- Yale New Haven Hospital
- VA Greater Los Angeles Healthcare System

For a more detailed description of the Clinical Engineering Internship Program, see Appendix A.

BIOMEDICAL ENGINEERING PROGRAM INFORMATION

Application, Admission Procedure and Deadlines

Students with a B.S. degree in Biomedical Engineering are ideally suited for the Biomedical Engineering M.S. and Ph.D. studies at the University of Connecticut. Students with a B.S. degree in engineering, physical sciences or mathematics may also seek admission to the Biomedical engineering Graduate Program at the University of Connecticut. Students with a non Engineering degrees will ordinarily need to take at least the required undergraduate Biomedical Engineering courses at the University. Students with life science undergraduate degrees generally take remedial course work in basic and advanced engineering and mathematics (two years through differential equations) and the required undergraduate biomedical engineering courses at the University. Course descriptions can be found in the Undergraduate Catalog (http://www.catalog.uconn.edu/). Note that these undergraduate courses do not count toward the Biomedical Engineering Graduate Program degree requirements.

The GRE and TOEFL scores are required only for students with a degree from a non-US institution. While there are no minimum GRE requirements, students entering the graduate program score well above 700 out of 800 in the quantitative portion of the GRE. (The UConn institutional code number for the GRE is 3915.)

The Biomedical Engineering graduate program does not require or review preliminary applications. All applications must be submitted on-line through the Graduate School. All students interested in applying to the program should to go http://www.grad.uconn.edu/prospective/online.html for more information.

Applicants are required to submit to the Graduate School:

- ❑ two letters of recommendation (preferably from members of the academic profession)
- ❑ a personal statement from the student describing his/her interest in biomedical engineering, indicate which of the six areas he/she wishes to pursue, and any other information that might be helpful for evaluation purposes
    - Areas of interest are:
        - **Biomaterials**
        - **Biomechanics**
        - **Biomedical Imaging and Biosensors**
        - **Clinical Engineering**
        - **Bioinformatics and Systems Genomics**
        - **Neuroengineering**
- ❑ official transcript

On the application form, specify Biomedical Engineering in the Field of Study. It is highly suggested that applicants list a preferred advisor on the application. A list of Biomedical Engineering Graduate Faculty members can be found on page 26 of this handbook.

A graduate student who is admitted into the Biomedical Engineering Graduate Program for a master's degree, a temporary faculty advisor will be assigned. A graduate student is admitted into the Biomedical Engineering Graduate Program for a PhD degree only if a Biomedical Engineering faculty has agreed to serve as the major advisor. **All applicants are encouraged to communicate directly with a potential major advisor at the time of the graduate application submission.**

The minimum GPA for admission to the Biomedical Engineering graduate program is 3.0, which makes the candidate eligible to be admitted with the "Regular" status.

Applicants with a GPA just below a 3.0, may on rare occasions, be admitted to the graduate program with the status of a "Provisional" graduate student. There is no financial aid possible for a "Provisional" status graduate student. After taking 12 credits of graduate coursework with a 3.0 or better GPA, the status is changed from "Provisional" to "Regular." Students with a grade average below 3.0 GPA after taking 12 credits of graduate coursework are removed from the program.

Application Processing Fee

A non-refundable fee must accompany the application. It may not be applied toward other charges. This fee must accompany every application submitted except for a doctoral degree program to follow immediately a master's degree program in the same field at this university. **There is absolutely no waiver for this fee.**

Financial Support

Financial support (graduate assistantships) is offered in the Biomedical Engineering Graduate Program through research and teaching assistantships. Research assistantships are provided directly from the Biomedical Engineering faculty. **Applicants should correspond directly with the faculty members that best match their research interests to learn about research assistantship opportunities. Teaching assistantships when available are awarded to graduate students with the necessary background for the course.** There is no financial aid form used by the Biomedical Engineering Graduate Program.

International Applicants

Students who are not United States citizens or permanent resident aliens must meet the additional requirements before their admission is finalized:

1. They must present documentary evidence of their ability to meet all expenses for at least the first year of study and an acceptable plan for financing the remainder of their program.

2. Students whose native language is not English must show evidence of proficiency in the English language by having earned a written score of at least 550 for the paper-based test, 213 for the computer-based test, or 80 for the Internet-based test on the TOEFL (Test of English as a Foreign

Language), administered by the Educational Testing Service, Princeton, New Jersey.[1]

3. The Graduate Record Examination General Test (GRE) is required only for students with a B.S. degree from a non-US institution.

Application Deadlines

Admission is only accepted for the *Fall* semester. Complete application packages must be received by January 1st for all applicants.

All credentials, including official transcripts covering all undergraduate and graduate work taken up to the time of application, as well as the non-refundable processing fee, must also have been received in the Graduate Admissions Office before being forwarded the Biomedical Engineering Graduate Program. Because research assistantships are filled far in advance, prospective students are encouraged to submit their applications for admission as early as possible. Applications for the Clinical Engineering Internship are due by January 1st. Please see Appendix A of the Biomedical Engineering Graduate Program Handbook for requirements.

M.S. Degree and Curriculum

Master's degrees may be earned under either of two plans, as determined by the advisory committee. The first plan (Plan A) emphasizes research, while the second (Plan B) requires comprehensive understanding of a more general character. Plan A requires no fewer than fifteen credits of advanced course work and, not fewer than nine additional credits of Master's Thesis Research (GRAD 5950 or GRAD 5960), as well as the writing of a thesis. Plan B requires no fewer than twenty-four credits of advanced course work, but no thesis. In either case, advisory committees may require more than the minimum number of credits.

Once a student begins a Plan A M.S. degree program and receives a graduate research assistantship, he or she can switch to a Plan B only if approved by the Major Advisor. It is also possible, with identification of a research project and approval from his or her Major Advisor, to change from Plan B M.S. degree program to Plan A.

Plan A

Plan A requires no fewer than five graduate courses (15 credits) of advanced course work and, not fewer than nine (9) additional credits of Master's Thesis Research (GRAD 5950 or GRAD 5960), as well as the writing of a thesis. Most students take two classes a semester and leave the summers free to work on their Master's Thesis. During the first year, the student identifies a project, writes a Master's Proposal, and after approval from the advisory committee, begins work on a Master's Thesis.

Students are expected to present and publish their Master's Thesis at a conference (or have their paper accepted) before graduation. Information on Master's Proposal, Project and Thesis

[1] University policy requires that all graduate students who will be serving as teaching assistants will be required to present evidence of competence in spoken English. This may take the form of a score of 50 or better on the Test of Spoken English if the student's native language is not English and if the student does not hold a degree from an Anglophone college or university. Further information is available from the Graduate Admissions Office or at http://grad.uconn.edu/international.html.

requirements can be found at http://grad.uconn.edu/current/MSProg.html.

Plan B

The Plan B Master of Science in Biomedical Engineering requires a total of eight (8) graduate courses (24 credit hours).

There are no publication requirements for Plan B M.S. degree students.

Minimum Requirements for MS Degree

Plan A (with thesis)	Requirements	Plan B (non-thesis)
15 credits	**Course Credits**	24 credits
3 engineering, 1 life sciences, 1 elective	**Core Courses**	5 engineering, 1 life sciences, 2 elective
9 credits (GRAD 5950)	**Research Credits**	None
2 credits (seminar)		2 credits (seminar)
Thesis	**Publications**	None
Thesis defense	**Pass Oral Exam**	Based on coursework

Note that all BME MS students are required to take at least two semesters of the Graduate Seminar. Plan A Master's students are required to present their work at least once. These credit hours will be counted toward the total credit requirement but not towards advanced course credits. **This requirement does not apply to students in the Clinical Engineering Program, and does not apply to part-time students.**

Life Sciences Courses- To help integrate biology into your engineering experience, we require that you take at least one life science course recommended on the BME course website at http://www.bme.uconn.edu/tracks-and-coursework.php. Courses are typically selected from anatomy and physiology, cell and molecular biology or biophysical chemistry, but are not limited to these areas.

Engineering Courses- An engineering course should be any engineering course recommended on the BME Course Track List at http://www.bme.uconn.edu/tracks-and-coursework.php.

Elective Courses- Graduate level courses which will be selected in consultation with the Major Advisor in the area related to the student's research in engineering and science.

Advisory Committee

The advisory committee is formed after consultation between the major advisor and the student. This committee must include, in addition to the major advisor, two associate advisors. At least one associate advisor must be from the Biomedical Engineering graduate faculty, and at least one of them must hold a current appointment as an associate graduate school faculty member. Degree programs are planned by the advisory committee after consultation with the student. The advisory committee should be formed before the student has completed twelve credits of degree program course work and shall then supervise the remainder of the student's degree program. A student's final plan of study will not be approved for conferral by the Graduate School unless reviewed and signed by the advisory committee (major advisor and at least two associate advisors).

Non-Degree and Transfer Credit

Up to six credits of advanced course work taken on a non-degree basis at the University of Connecticut may be included on a Master's degree plan of study provided the following conditions are met:

(1) The grades earned in such course work are *B* (not *B*-) or higher;

(2) Such course work is within the six-year limit for completion of Master's degree requirements; and

(3) Such credits have not been applied toward any other degree, here or elsewhere (already completed or to be completed in the future).

In any event, inclusions of non-degree course work on the plan of study requires the consent of the advisory committee.

Up to six credits of advanced course work completed or to be completed at other institutions may be approved for transfer to the student's Master's degree program at the University of Connecticut. Such credits are to be listed "below the line" on the plan of study. The following conditions must be met before final approval of any transfer of credit is granted:

(1) The advisory committee must indicate its approval of the transfer of credit by signing the plan of study;

(2) The courses must be at a level appropriate for a graduate degree and offered by an accredited institution; and

(3) The grades earned in any courses to be transferred must be *B* (not *B*-) or higher.

Official transcripts of any course work to be transferred must be on file in the Graduate School. When the student's plan of study has gained the approval of the Executive Committee and official transcripts indicating satisfactory completion of the course work to be transferred are received, the transfer of credit is noted on the student's permanent academic record. Any credits transferred to a graduate degree program at the University of Connecticut must not have been used toward a degree elsewhere (already completed or to be completed in the future).

Candidacy and Plan of Study

To become a candidate for a Master's degree, the student must have on file with the Graduate School a plan of study prepared with the aid and approval of an advisory committee and approved by the Executive Committee of the Graduate Faculty Council. The Plan of Study form can be found at http://grad.uconn.edu/forms.html. (A sample of this form is included in Appendix C.) In order for a student to be eligible for graduation with a Master's degree, the student must have been granted Regular status and have a cumulative GPA of 3.0 or higher. The student may not take the final examination for the degree before the plan of study has been fully approved. The plan of study must be prepared in duplicate (two original copies), and signed by the student and the members of the advisory committee. Both copies must be submitted to the Biomedical Engineering Graduate Program when the student has completed not more than twelve credits of course work to be applied to the degree.

Master's Degree Plans of Study must consist of only courses at the 5000's level or above. In addition to the minimum number of course credits required for the degree, the advisory committee may

require the student to take other courses with or without graduate credit, depending on the student's objectives and previous preparation. After approval of the plan by the Executive Committee, any request for change must be submitted to the Graduate School on the "Request for Changed in Plan of Graduate Study" form bearing the signatures of the advisory committee and the student for approval by the Executive Committee. Successful completion of all work indicated on the approved plan of study is a fundamental prerequisite to the conferral of the degree. Once the plan of study is approved, the student and the advisory committee should reevaluate it regularly and modify it, following the established procedure, if appropriate.

Master's Proposal, Project and Thesis Requirements for Plan A

The Master's Thesis Proposal should be written in the third person and consist of the following items:

- Title Page with Thesis Title, Student Name and address, Major Advisor, Committee Members
- 1 Page Executive Summary (Abstract) that describes the problem investigated and its importance
- 2-3 pages of background information so that the project is placed in historical context or its importance within the field
- 2-3 pages on the solution to the problem
- A detailed timeline to be followed to the completion of the project
- References Cited
- A list of any publications in this project that you have authored or co-authored

The Master's Thesis is a document that describes a project carried out by the student. Style documentation for the Master's Thesis is available from the Graduate School website, http://grad.uconn.edu/current/MSProg.html. Typically, this includes the following sections:

- Title
- Signed Approval Page
- Abstract
- Introduction
- Methods
- Results
- Discussion
- Conclusion
- Appendix
- List of conference or journal publications authored by the candidate in fulfillment of the publication requirement.

The introduction should describe background history that illustrates the relevance of the project. It should also provide a roadmap for the rest of the thesis.

The advisory committee must approve the topic and scope of the thesis required under Plan A and upon its completion, ascertains that it represents an independent investigation of a significant topic and is an important contribution to ongoing research in the candidate's field. The thesis must be acceptable in literary style and organization. The Master's thesis may not include any data or research

results that cannot be made public at the time of the oral defense. The thesis is regarded as an important part of the student's program. It is the student's responsibility to be certain that the thesis conforms exactly to the specifications prescribed by the Graduate School at http://grad.uconn.edu/current/MSProg.html.

Final Examination

Plan A (with thesis)	Plan B (non-thesis)
Based on course performance & passing thesis defense	Based on course performance
All engineering courses with a grade of B or higher	All engineering courses with a grade of B or higher

Timeline

The program usually takes two academic years of coursework and for Plan A graduate students, completion of a Master's project. All work for the Master's degree must be completed within a maximum period of six years from the beginning of the student's matriculation in the degree program. Failure to complete the work within this period or failure to maintain continuous registration will require reevaluation of the student's entire program and may result in termination.

Graduate Assistants Start Date, End Date, Holidays and Work Hours

The time commitment by a graduate assistant (GA), either a teaching assistant (TA) or a research assistant (RA), is at least 20 hours per week for a full-time appointment.

During the academic year, the GA's vacation schedule usually coincides with holidays observed in the University of Connecticut academic calendar (from August to May). However, some assistantships may be year round. RAs are responsible for discussing their schedule with the major advisor funding them and TAs are responsible for discussing their schedule with the Biomedical Engineering Program Director.

Please refer to the Graduate Course Catalog for more information on vacations, sick days and university closings (http://catalog.grad.uconn.edu/grad_catalog.html/).

Conferral of Degrees

Degrees are conferred three times each year – May, August, and December (check the Academic Calendar for specific dates). There is one commencement ceremony a year, which is held at the end of the spring semester. Students who have completed all requirements for a degree (including the formal application for the degree described below) by the final day of the summer or fall conferral periods or, for doctoral candidates, not later than the Friday prior to commencement in May receive their diplomas by mail, normally during the fifth month following conferral.

Application for the Degree

Formal application must be filed on the official form provided by the Graduate Records Office or by going to http://grad.uconn.edu/current/applygraduation.html. If filing is not timely, conferral is delayed to the next conferral period, even though all other degree requirements may have been completed on time.

Documents needed for Conferral

A Plan of Study and Report on the Final Exam must be signed by the major advisor and at least two associate advisors and submitted to the Biomedical Engineering Graduate Program and the Graduate School. Additionally, The Clearance Notice for Engineering Students Completing a Graduate Degree ("key clearance form") must also be submitted to the Graduate Program after the major advisor has signed off that the student has returned their keys. These forms can all be found on the Graduate School website, http://grad.uconn.edu/forms.html. As of Fall 2010, all graduating BME students must complete the BME Graduate Conferral Checklist. This form can be found on the BME website http://www.bme.uconn.edu/graduate-forms-documents.php. Finally, students must complete the Graduate Survey form located at https://www.bme.uconn.edu/wp-content/uploads/2011/02/GradStudentSurveyS2011.pdf and return to the Biomedical Engineering Program before Commencement.

Commencement

Commencement is held once each year, at the end of the spring semester. Individuals who have had degrees conferred at the end of the previous summer or the previous fall semester and candidates for degrees at the end of the spring semester who complete degree requirements by the published deadline may participate in the annual commencement ceremony and are urged to do so. Academic regalia appropriate for the University of Connecticut degree being conferred is strictly required. Commencement instructions are available at the Office of the University Registrar during the last full week of classes, and are mailed to an off-campus address only at the degree recipient's or candidate's written request. Those who plan on participating in Commencement may go to http://www.commencement.uconn.edu/ for information participation confirmation, regalia and tickets.

Ph.D. Degree and Curriculum

Research required for the doctoral degree in biomedical engineering involves the use of advanced engineering techniques for the solution of a biological or medical problem. Students with a B.S. or M.S. degree are eligible to apply to the Biomedical Engineering Ph.D. program. Students with a B.S. or M.S. degree in Biomedical Engineering are ideally suited for Biomedical Engineering Ph.D. studies at the University of Connecticut.

Applicants to Ph.D. program are expected to demonstrate outstanding ability and show, based on their record of previous scholarship and experience, that they are likely to do superior creative work in their respective fields. Holding a Master's degree from this or any other institution does not render the applicant automatically admissible to a doctoral program. In general, doctoral applicants must meet all admission requirements for the master's degree as Regular graduate students and must present evidence that they are capable of doing independent work of distinction.

Students with a B.S. degree in either engineering or physical sciences or mathematics are encouraged to seek admission to the Biomedical Engineering Ph.D. program at the University of Connecticut. Students with non-engineering B.S. degrees will ordinarily need to take at least the required undergraduate Biomedical Engineering courses at the University of Connecticut (BME 3500, 3600W, and 3700- see the undergraduate catalog at http://www.catalog.uconn.edu/ for course descriptions). Students with life science undergraduate degrees must normally take remedial course work in basic

and advanced engineering and mathematics (two years through differential equations) and the required undergraduate Biomedical Engineering courses at the University of Connecticut.

Students with M.S. degrees in areas of engineering other than biomedical engineering will ordinarily need to take at least the five core BME M.S. courses at the University of Connecticut (as outlined in "M.S. Degree and Curriculum").

Note: Remedial B.S./M.S. Bioengineering course work does count toward the Biomedical Engineering Ph.D. program degree requirements.

A minimum of 15 credits of advanced course work, beyond the M.S., are required for the Ph.D. Additionally, 15 credit hours of GRAD 6950 "Doctoral Dissertation Research" are required.

A minimum of 30-33 credits including 30 credits of advanced course work, beyond the B.S., are required for the Ph.D. Additionally, 15 credit hours of GRAD 6950 "Doctoral Dissertation Research" are required.

MINIMUM Requirements for PhD

Without Master's	Requirements	With Master's
30 credits	**Course Credits**	15 credits
5 engineering, 2 life sciences, additional courses in consultation with major advisor	**Core Courses**	3 engineering, 1 life sciences, additional courses in consultation with major advisor
15 credits (GRAD 6950)	**Research Credits**	15 credits (GRAD 6950)
6 credits (independent studies, additional courses, seminar)	**Credits**	2 Seminar credits
Two, one accepted	**Publications**	Two, one accepted
Based on core course performance	**Qualifying Exam**	MS and/or core course performance
Dissertation Proposal	**General Exam**	Dissertation Proposal
Dissertation Defense	**Final Exam**	Dissertation Defense

All BME PhD students are required to take at least two semesters of the Graduate BME Seminar. PhD students are required to present their work during these seminars. These credits hours will be counted toward the total credit requirements but not towards advanced course credits.

Under the Ph.D. curriculum, students must take a minimum three engineering courses and a minimum one life science course to satisfy graduation requirements. You will work with your major advisor and advisory committee to select the additional courses that fit the definitions below and are most relevant to your career goals.

Life Sciences Courses- To help integrate biology into your engineering experience, we require that you take at least one life science course recommended on the BME course website at http://www.bme.uconn.edu/tracks-and-coursework.php. Courses are typically selected from

anatomy and physiology, cell and molecular biology or biophysical chemistry, but are not limited to these areas.

Engineering Courses- An engineering course should be any engineering course recommended on the BME Course Track List at http://www.bme.uconn.edu/tracks-and-coursework.php.

Elective Courses- Graduate level courses which will be selected in consultation with the Major Advisor in the area related to the student's research in engineering and science.

Advisory Committee

The advisory committee is formed after consultation between the major advisor and the student. This committee must include, in addition to the major advisor, at least two Biomedical Engineering graduate faculty members. In addition to the three or more members chosen in the usual way, another member, ordinarily a member of the graduate faculty outside the student's field of study but in a related field may be appointed by the Dean of the Graduate School.

Degree programs are planned by the advisory committee after consultation with the student. The advisory committee may require more than the required minimum credit hours of course work beyond the BS or M.S. degree based on the academic credentials of the student (i.e., the student enters the program without a Biomedical Engineering degree and/or life science background) or adds courses to address the student's research focus. The advisory committee should be formed before the student has completed twelve credits of degree program course work and shall then supervise the remainder of the student's degree program.

Biomedical Engineering Program Requirement

Two journal papers must be submitted to a leading Biomedical Engineering journal before graduation (with at least one of them having gone through the review cycle favorably and accepted).

Time Limits

The equivalent of at least three years of full-time study beyond the baccalaureate or two years beyond the master's degree (in the same or a closely related field) is required. All work must be completed within a period of eight years of the beginning of the student's matriculation in the degree program, or, if the student entered with a master's degree in the same or a closely related field, the doctorate must be completed within seven years. The general examination must be passed within five years of the beginning of the student's matriculation in the degree program, or within four years if the student entered with a master's degree in the same or a closely-related field. Failure to complete the work within the periods specified or failure to maintain continuous registration (see "Continuous Registration" in the Graduate Catalog) will require reevaluation of the student's entire program and may result in a notice of termination. A five-year time limit applies to the acceptability of foreign language courses. (See "Foreign Language; Related or Supporting Area of Study" in the Graduate Catalog http://catalog.grad.uconn.edu/grad_catalog.html).

A one-time extension of the student's terminal date of no longer than two years is considered only when there is substantial evidence that the student has made regular and consistent progress toward completion of degree requirements. A detailed recommendation to extend the terminal date must be submitted in a timely manner to the Graduate School. Approval is granted by the Dean.

Residence Requirement

The graduate student can fulfill the special demands of a doctoral program only by devoting a continuous period of time to concentrated study and patient research with a minimum of outside distraction or employment. During the second or subsequent years of graduate work, at least two consecutive semesters must be completed in residence. Alternatively, this requirement may be met by combining one semester of residence plus a contiguous 12-week summer period made up of Summer Sessions I & II or Summer Session IV, if agreed upon by the advisory committee and the student. The residence period must be completed at the Storrs campus or, if more appropriate, at one of the other sites of instruction and research within the University system.

Plan of Study

The Biomedical Engineering program requires a plan of study which can be found at http://grad.uconn.edu/forms.html. (A sample of this form is included in Appendix C.) The work presented for the Ph.D. degree should equate to 44 to 48 credits beyond the baccalaureate or its equivalent. At least 15 credits of GRAD 6950 (Dissertation Research) must be included in the plan of study, representing the research effort the student devotes to the research leading to the dissertation.

No course credit is given for the dissertation, but the research toward it is associated with the 15 or more credits of GRAD 6950 required of students. The dissertation is regarded as an important part of the student's program and is considered to represent at least one year of full-time graduate study.

Advanced course work taken on a non-degree basis at the University of Connecticut may be included for a Ph.D. provided the following conditions are met:

(1) The grades earned in such course work are *B* (not *B*-) or higher;

(2) Such course work is within the seven or eight year limit (whichever applies) for completion of Ph.D. degree requirements; and

(3) Such credits have not been applied toward any other degree here or elsewhere (already completed or to be completed in the future).

In any event, inclusion of non-degree course work on the plan of study requires the consent of the advisory committee and is subject to the approval of the Executive Committee.

Please refer to the Graduate Course Catalog for more information (http://catalog.grad.uconn.edu/grad_catalog.html).

Foreign Language; Related or Supporting Area of Study

The Biomedical Engineering PhD program does not require a related area of study nor demonstrated reading knowledge of a language other than English. Please refer to the Graduate Catalog for more information (http://catalog.grad.uconn.edu/grad_catalog.html).

Transfer Credit

Transfer of credit for course work completed at other institutions is approved only after the student has demonstrated the ability to do acceptable graduate work at the University of Connecticut. Such ability must be demonstrated by successful completion of graduate-level, University of Connecticut course work. The equivalent of two years of graduate work completed at accredited institutions may

be accepted, provided it is of at least B (not B-) quality, contributes to the objectives of the proposed doctoral program, and is not work previously completed already being offered toward a related or supporting area. Such graduate work may be approved for transfer provided that the general examination is passed and all degree requirements are to be completed within the prescribed periods - respectively, four or five years and seven or eight years - from the beginning date of the earliest course, wherever taken, listed on the approved doctoral plan of study (See "Time Limits"). Transfer credit is not granted for individual courses used toward a degree elsewhere (already completed or to be completed in the future). Instead, consideration is given to that degree program as an entity when the doctoral coursework is being prepared.

Evaluation of Performance

The advisory committee continually evaluates the student's performance. Any graduate student whose scholastic record does not meet the minimum requirements of the Graduate School may be subject to dismissal. However, the committee may insist on more than the minimum scholastic requirements and may take other factors into consideration in deciding whether or not to recommend to the Dean that the student be permitted to continue in the degree program.

Ph.D. Qualifying Examination:

- **The Qualifying Exam will be based on course performance. Students must have a B or higher in all engineering coursework.**

Ph.D. General Examination:

Will be based on the Dissertation Proposal and oral presentation

- **Objective:** The objective of the General Exam is to evaluate a Ph.D. candidate's competency in developing and formulating a research project and the student's ability to approach a new problem in ways appropriate for an independent scientist. This ability is certainly difficult to test but is central to the notion that passing the general exams qualifies one to prepare the Ph.D. dissertation. This includes identifying the context/importance of the proposed research, the implications of the research, as well as, applying appropriate methods to perform the research. The exam emphasizes the candidate's ability to draw together and synthesize material from different courses, readings, seminars and experimentations.

- **Who should take this exam:** All Ph.D. candidates must take this exam no later than eight months before defending their dissertation.

- **Timing:** The timing of the exam will be arranged between the student and the student's Ph.D. advisory committee. The general examination is usually taken near the end of the course program, but not later than eight months prior to the date of completion of all degree requirements. In any event, the examination must be passed within five years of the beginning of doctoral study or within four years if the student entered with a master's degree in the same or a closely related field. The beginning of doctoral study is defined as the beginning date of the earliest course, wherever taken, listed on the approved doctoral plan of study. The student may not take the general examination before the plan of study has seen approved by the Executive Committee.

- The **Examiners:** The examining committee includes at least one faculty member representing each of the major areas addressed in the examination. Not fewer than five faculty members, including all members of the student's advisory committee, must participate in the examination. All examiners are invited to submit questions and to evaluate answers, but the final decision as to whether or not the student has passed the examination shall rest solely with the advisory committee unless the members of the Graduate Faculty in a student's field of study have voted to assign this authority to a differently constituted examining committee.

- **Exam Contents:** The exam will consist of a research proposal based on the student's research project. At least two weeks prior to the exam, the student will submit a written research proposal (12-15 pages) to the advising committee. The general exam is mainly an oral defense of this research proposal by the student. The committee tries to evaluate the candidate's competency in developing and formulating the research project, as well as the scientific merits of the project, research hypothesis, research methods, potential findings, implications and limitations. The examiners will also assess the breadth and depth of the student's knowledge in areas essential to carry out the research project.

After the examination, the major advisor communicates the results to the candidate and immediately sends the "Report on the General Examination for the Doctoral Degree" form to the Graduate School. This form can be found at http://grad.uconn.edu/forms.html and must bear the signature of each member of the advisory committee. Should the committee permit the student to take the examination in several sections, only the final result should be reported.

Dissertation Proposal

Before dissertation research is undertaken, the student is required to prepare and submit for advisory committee and external review a dissertation proposal addressing the intended research, following the guidelines contained on the "Doctoral Dissertation Proposal Coversheet and Instructions" from the Graduate School website, http://grad.uconn.edu/forms.html. Failure to file the dissertation proposal early may result in wasted effort on a dissertation if changes are required in the project.

Ordinarily, it is expected that a Dissertation Proposal will be prepared and fully approved before preparation of the dissertation is well underway. If human and/or animal subjects are involved in the dissertation research, approval must be secured **before** the research is undertaken from the Institutional Review Board (IRB) and/or the Institutional Animal Care and Use Committee (IACUC) respectively. Approval of the Embryonic Stem Cell Research Oversight Committee (ESCRO) must be obtained in advance for any use of human stem cells in dissertation research.

When the dissertation proposal has been completed and signed by the student and also has been approved by the members of the advisory committee, the proposal then is submitted to the Biomedical Engineering Program Director. The director appoints reviewers from outside the advisory committee to conduct a critical evaluation of the dissertation proposal. The use of at least one reviewer from outside the University is encouraged. Reviewers may be appointed to evaluate an individual student's proposal, or they may be appointed to a committee responsible for reviewing all proposals in a particular field of study or group of related fields of study.

Dissertation proposals are reviewed with the following questions in mind:

(1) Is the proposal well written, well organized, and well argued?

(2) Does the proposal describe a project of appropriate scope?

(3) Does the student demonstrate knowledge of the subject and an understanding of the proposed method of investigation?

(4) Does the student show awareness of the relevant research by others? and

(5) Does the student consider how the proposed investigation, if successful, will contribute to knowledge?

The department or program head's signature on the proposal when the review is completed confirms that the results of the review were favorable. The evaluation may take the form of a reading of the proposal or attendance at an oral presentation and discussion of the proposal. A copy of the signed approval form and dissertation proposal must be received by the Graduate School when the review process has been completed. Receipt by the Graduate School of the approved Dissertation Proposal and any required IRB, IACUC, or ESCRO approval is a basic requirement for eligibility to schedule the oral defense of the dissertation and for conferral of the doctoral degree.

Candidacy and Dissertation Preparation

Upon approval of the plan of study, passing the general examination and having had the dissertation proposal accepted by the Executive Committee of the Graduate Faculty Council, the student becomes a candidate for the degree of Doctor of Philosophy. Students are notified of their advancement to Candidacy.

A dissertation represents a significant contribution to ongoing research in the candidate's field and is a primary requirement. The preparation of the dissertation is under the immediate and continuous supervision of the advisory committee and it must meet all standards prescribed by the committee and by the Graduate School. Specifications for its preparation may be obtained at http://grad.uconn.edu/current/dissertation.html. It is the student's responsibility to be certain that the dissertation conforms exactly to the specifications prescribed by the Graduate School.

Dissertation Defense

The final examination or dissertation defense is oral and it is under the jurisdiction of the advisory committee. It deals mainly with the subject matter of the dissertation. The examination may not be held sooner than seven days after a working copy of the complete dissertation has been submitted to the Graduate School (or the Health Center) and by conferral period deadline in August, December or May (respectively, August 31, December 31, or no later than the Friday prior to commencement in May). Invitation to participate in the examination is issued by the advisory committee, although any and all members of the faculty may attend. Not fewer than five members of the faculty, including all members of the candidate's advisory committee, must participate in the final examination, unless written approval for a lesser number has been secured in advance from the Dean of the Graduate School.

The student is responsible for informing of the Biomedical Engineering Program that they are prepared to schedule their dissertation defense. If student intends to hold their defense at the Health Center, they are responsible for reserving the space necessary. The student's major advisor must inform the Biomedical Engineering Program that the dissertation abstract has been approved. It is

also required that notification of the time, date, and place of the examination be posted at least two weeks prior to the examination. Instructions for posting the announcement on the University of Connecticut events calendar are available at http://www.grad.uconn.edu/announcing.html. In addition, the examination should be advertised widely in the candidate's department and elsewhere throughout the University, as appropriate.

The decision regarding whether a candidate has passed, conditionally passed, or failed the examination rests solely with the advisory committee, which will take into account the opinions of other participating faculty members and other experts. The vote of the advisory committee must be unanimous. Immediately following the examination, the major advisor communicates the results to the student and sends the official report on the examination to the Graduate School.

Conferral of Degrees

Degree conferral requires that the student be in good academic standing and that all requirements for the degree have been completed satisfactorily on or before the last day of the conferral period. Degrees are conferred three times each year – in August, May and December – although there is only one annual graduate Commencement ceremony at which graduate degrees are awarded (in May). Students who qualify for degree conferral receive their diplomas by mail, normally within three months following conferral.

Application for the Degree

Formal application must be filed online by the degree candidate using the PeopleSoft system. Information and instructions are available at http://grad.uconn.edu/current/applygraduation.html. If filing is not timely, conferral is delayed to the next conferral period, even though all other degree requirements may have been completed on time.

Commencement

Commencement is held once each year, at the end of the spring semester. Individuals who have had degrees conferred at the end of the previous summer or the previous fall semester and candidates for degrees at the end of the spring semester who complete degree requirements by the published deadline may participate in the annual commencement ceremony and are urged to do so. Academic regalia appropriate for the University of Connecticut degree being conferred is strictly required. Commencement instructions are available at the Office of the University Registrar during the last full week of classes, and are mailed to an off-campus address only at the degree recipient's or candidate's written request. Those who plan on participating in Commencement may go to http://www.commencement.uconn.edu/ for information participation confirmation, regalia and tickets.

UCONN PROCEDURES FOR INTERNS AND STUDENTS SUPPORTED WITH A GRADUATE ASSISTANTSHIP

Summer before 1st Year

During the summer, a package will be sent in the mail that includes instructions and the following documents:

- Graduate payroll information (Federal W-4 tax form, I-9 Form, CT W-4 tax form)
- Medical insurance forms
- EEO Designation Sheet
- Employee information form
- International students need to submit I-94 and I-20 forms.

The forms should be completed according to the instructions contained in the packet. These forms take 4-5 weeks to process. Therefore, it is important that these forms be received no later than July 15th. The first paycheck is the first pay period after the beginning of the academic year (August 23rd). Health benefits begin Oct. 1st and continue through Sept. 30th of the next year. If the forms are not received by July 15th, it takes 4-5 weeks to process the paperwork and the first paycheck will be received 6 weeks to 2 months after submission (but no earlier than the first pay period after the beginning of the academic year -August 23rd).

Preliminary Registration for courses

Schedule a meeting with your major advisor to discuss courses for the next semester at least a week before graduate registration begins. International students cannot register for classes until they have completed the orientation session just before the beginning of the semester. Courses are listed on the Biomedical Engineering web site at: http://www.bme.uconn.edu.

Continuous Registration

Master's degree students, having started their degree programs, are required to register for and complete at least one appropriate course for credit within each twelve-month period, unless they have taken all course work on an approved master's plan of study and are reading for a master's final examination or preparing a thesis. Any master's degree student with course work remaining on the plan of study, who fails to complete any course work for credit in a twelve-month period, is subject to severance from his or her degree program. To be reinstated, the student must apply for readmission, with no certainty of being accepted.

All degree students must begin their programs with course work for credit and must maintain registration continuously each semester thereafter (except summer sessions) until all requirements for the degree have been completed. Registration may be maintained either by taking course work for credit or by registering for one of the four non-credit Continuing Registration courses. These include

Special Readings at the master's (GRAD 5998) or doctoral (GRAD 6998) level, Master's Thesis Preparation (GRAD 5999), and Doctoral Dissertation Preparation (GRAD 6999). Other zero-credit courses may be substituted, if appropriate. Non-credit registration requires payment of the Graduate Matriculation Fee as well as the appropriate level of the General University Fee. Failure to maintain continuous registration during any semester results in the student's inactivation. Reinstatement is possible only after payment of all fees in arrears and the reinstatement fee.

Neither enrollment for Continuing Registration nor payment for it is required for any semester, during the first ten class days of which the student completes all requirements for a degree, if it is the only degree the student is pursuing.

Any currently matriculated student taking course work at another institution, either for transfer to a University of Connecticut graduate degree program or for any other reason, must register for Continuing Registration as specified above in any affected semester.

Enrollment in Continuing Registration is not required during the summer except as follows. A degree student, if not otherwise registered for the summer, must register for Continuing Registration and pay the Graduate Matriculation Fee if the student is fulfilling in part the doctoral residence requirement during the summer. To receive most forms of summer financial aid for study or research, a student must register for either 5 credits of coursework in each of two summer sessions or one of the full-time research courses, GRAD 5960 (Full-time Master's Research) or GRAD 6960 (Full-time Doctoral Research). Registration during the summer is done through the Office of Summer Sessions.

Registration Deadlines

All graduate students registering with the University must do so no later than the close of business of the tenth day of each semester. Beyond that point, a late registration and reinstatement fee will be imposed.

Course Loads

The number of credits and choice of courses for which a student registers is a matter to be discussed by the student and the major advisor. A student may be classified as a full-time student in one of three ways:

(1) Enroll in 9 or more credits of course work;

(2) Enroll in 6 or more credits of course work while holding a graduate assistantship (50% or greater); or

(3) Enroll in one of the four special purpose 3-credit courses.

These courses include GRAD 5960 (Full-time Master's Research), GRAD 6960 (Full-time Doctoral Research), GRAD 5930 (Master's Level Directed Studies), and GRAD 6930 (Doctoral Level Directed Studies). The former two courses may be taken by students who have completed all requirements for the respective degree except the research component and who have no other obligations at the University (i.e., no other course work and no graduate assistantship). The latter two courses denote a full-time off-campus directed project, such as an internship, field work, or other special activity. Students in GRAD 5930 or GRAD 6930 may hold graduate assistantships if those assistantships are in direct support of their studies. Such an assistantship may not be a standard teaching assistantship.

To be classified as half time, the student's course credit load must be between 5 -8 credits per semester. A credit load of less than 5 credits per semester is a part-time load. These criteria apply to all registered students at the University. The currently defined Continuing Registration courses (GRAD 5998, 5999, 6998, and 6999) are zero-credit "placeholder" courses denoting part-time study and do not count toward the credit load requirement for half-time or full-time enrollment status. Degree-seeking students who do not need to be certified by the University as holding at least half-time enrollment status may use these courses to maintain registration on a part-time basis.

Students holding graduate assistantships must register for 6 or more credits per semester. Such students are considered to be full-time students.

In addition to courses offered by the program, a student's credit load may include GRAD 5950 (Thesis Research), GRAD 6950 (Dissertation Research), and other equivalent research courses defined by the Graduate School, including seminar and other "colloquium" courses that are not part of the plan of study. These variable credit courses carry pass/fail (S/U) grading, with the student's major advisor as the instructor of record.

Checklist for Students Registering for Graduate Courses

First Semester:

1) Meet with major advisor to discuss courses
2) Obtain from the Graduate School:
   a) PeopleSoft ID (also called EmplID) and password for PeopleSoft Student Admin System
   b) PeopleSoft Student Admin System is used to register for courses online
3) Register for courses through PeopleSoft
4) Wilbur Cross Building:
   a) Obtain Student ID from HuskyOne Card Office
   b) Pay Fee Bill at Office of the University Bursar
5) Department of Parking and Transportation Services
   a) Parking permit (if necessary)
   b) http://www.park.uconn.edu/

Second Semester through Degree Conferral

1) Meet with major advisor and/or advisory committee to discuss courses
2) Register for courses
3) Pay Fee Bill at the Office of the University Bursar in the Wilbur Cross Building

FACULTY, FACILITIES AND OTHER INFORMATION

Graduate Advisors in Biomedical Engineering

Major Advisors: The major advisor is the chair of the thesis/dissertation advisory committee. The major advisor is responsible for coordinating the supervisory work of the advisory committee (course of study and research program of the student). In some instances, the major advisor may choose to involve a thesis advisor to assist with the graduate research program for the student. Because of the interdisciplinary nature of the Biomedical Engineering field of study, graduate research facilities in biomedical engineering are diverse, and can be found in the various academic departments of the biomedical engineering major advisors on the Storrs campus and at the University of Connecticut Health Center in Farmington.

Core and Affiliated Faculty: see http://www.bme.uconn.edu/faculty.php

Adjunct Faculty: The adjunct faculty is a member of the thesis/dissertation advisory committee and cannot serve as a Major Advisor.

Emeritus: Emeritus professor who can no longer serve as a major advisor, but can be an associate advisor.

Research

Biomedical Engineering faculty members, from engineering, biology, biomedical sciences, materials sciences, chemistry, physics, medicine, and dental medicine, form an interdisciplinary program that spans the University of Connecticut to offer research programs in the broad areas of Bioimaging, Bioinformatics, Bioinstrumentation, Biomaterials, Biomechanics, Physiological and Biomedical Engineering Modeling, and Clinical Engineering. Within these broad areas, BME faculty embrace diverse, yet complementary, research areas including Artificial Organs, Biochemical Engineering, Bioelectric Phenomenon, Biofluid Mechanics, Bioimage Processing, Biomimetics, Biosensors, Biosignal Processing, Biotechnology, Cell and Tissue Mechanics, Clinical Engineering, Disease Detection and Diagnosis, Drug Delivery Systems, Ergonomics, Human Performance Modeling and Engineering, Human Movement Analysis, Medical Imaging, Medical Informatics, Neural Systems Engineering, Pharmokinetics, Rehabilitation Engineering, Regenerative Medicine, and Tissue and Cellular Engineering. BME faculty also work in University of Connecticut Research Centers such as the Center for Biomaterials, the Center for Biomedical Imaging Technology, the Center for Cell Analysis and Modeling, the Center for Public Health and Health Policy, the Center for Regenerative Biology, the Center for Regenerative Medicine and Skeletal Development, the Center for Vascular Biology, the Ergonomics Technology Center, and the Institute of Materials Science.

Student Organizations

Student Chapter of the Biomedical Engineering Society and the IEEE-EMBS Student Club are quite active and promote a seminar series, plan trips and fundraisers. Please visit our website at: http://www.bme.uconn.edu/stusocs/index.html for more information.

The BME Graduate Student Committee is an organization formed to represent the interests of the BME Graduate student body. This committee met for the first time in the Fall of 2009. Information about this group will be found at http://homepages.uconn.edu/~bmegsc/ .

The Student Associate of Graduate Engineers (SAGE) is a graduate student organization for School of Engineering, founded Sept 2010 and became official Feb 2011. The group will plan academic, social, and career planning events targeting graduate students. The primary objective of SAGE (Student Association of Graduate Engineers) is to serve as a mechanism through which engineering students can connect academically, professionally and socially. In addition, the committee will be involved in organizing seminars, job fairs, fundraising, and more. Through this committee, the students can participate and engage in the process of enhancing the SAGE and therefore the students' future. The engagement can be in the form of questions, comments or any other mean that can help the committee to organization and deliver the viewpoints of the graduate students to SAGE and the University of Connecticut. For more information, please visit http://sage.engr.uconn.edu/index.html.

LIVING ARRANGEMENTS

On-Campus Housing

Refer to the Graduate Handbook (http://catalog.grad.uconn.edu/) and the Office of Residential Life (http://reslife.uconn.edu/) for more information about on campus housing.

Off-Campus Housing

The Off-Campus Student Services (http://www.offcampus.uconn.edu/) is an excellent resource for information about finding off-campus housing, as well as understanding your right's as a renter, health and safety tips for renters, and many more useful services, programs and links for students living off-campus.

General Information

Where is Hartford and what is there to do there?

The Greater Hartford Area is located in Central Connecticut. Connecticut is bordered on the east by Rhode Island, on the west by New York, on the south by the Atlantic Ocean, and on the north by Massachusetts. Because of the state's location, there are many areas only a day trip away. For example, the ski slopes of Vermont, the sailboats of Newport, the casino at Foxwoods, the clubs of New York City, and the Red Sox of Boston are all within a two hour drive. For those wanting a quieter life, Connecticut itself is a beautiful New England state, with rolling hills, county fairs, and a lot of deer.

As for its capital city, Hartford has quite a bit going on. For instance, the Bushnell Theater puts on Broadway musicals, the XL Center offers sporting events, and the Meadows provides a place for the latest bands to perform as they tour from Boston to New York. The city also offers a wide range of restaurants, so if you like trying new food, you will not be disappointed. Check out the *Hartford Advocate* to get a feeling of what is happening each week. Or, try the following sources:

Hartford's homepage http://www.hartford.gov/
Hartford Visitor's homepage http://www.hartford.com/
Connecticut Vacation Center http://www.ctvisit.com/
Greater Hartford Convention & Visitors Bureau http://www.enjoyhartford.com/

How about Springfield, Bridgeport, and New Haven?

Springfield, Massachusetts, is a medium-sized city located just thirty minutes north of Hartford (making it two hours west of Boston). It is the home of the Basketball Hall of Fame as well as the Springfield Civic Center, which hosts many different events.
Western Massachusetts Homepage http://www.valleyvisitor.com/
Springfield's homepage http://www.springfieldcityhall.com

Bridgeport, Connecticut, is about an hour's drive from Hartford, making it half-way between

Hartford and New York City. Its claim to fame is that it is the biggest city in Connecticut.
Bridgeport's homepage http://ci.bridgeport.ct.us/

New Haven, Connecticut is about a forty minutes drive south of Hartford, along the water-front. New Haven is basically the cultural center for southern Connecticut, so it too offers many interesting opportunities for the adventurous.
New Haven's homepage http://www.cityofnewhaven.com/
New Haven Visitor's homepage http://www.visitnewhaven.com

What professional organizations will I be eligible to join?

With any profession come obligations to continue your education and further the development of your profession. There are a wide variety of organizations that you are eligible to join. Below is a short list of some of the more important organizations and a number to call to find more out about it.

- IEEE EMBS (Institute of Electrical and Electronics Engineers, Engineering in Medicine & Biology); www.embs.org
- BMES (Biomedical Engineering Society); www.bmes.org
- AAMI (Association for the Advancement of Medical Instrumentation); www.aimbe.org

The various activities of these organizations will include conferences, meetings, and critical networking to aid you in your professional career.

What libraries can I use?

The University of Connecticut has a large library consisting of relevant engineering material. The University of Connecticut Medical School Library (located at the University of Connecticut Health Center) is also quite comprehensive. All library facilities at the above institutions are available to all Biomedical Engineering graduate students.

APPENDICES

A. THE CLINICAL ENGINEERING INTERNSHIP

A. Clinical Engineering Internship

The Clinical Engineering Internship at the University of Connecticut is a hospital-based, two-year program that currently includes:

- The University of Connecticut Health Center – John Dempsey Hospital
- Hartford Hospital
- Baystate Health System
- VA Connecticut Healthcare System (West Haven)
- University of Massachusetts Memorial Medical Center (Worcester)
- Providence VA Medical Center
- VA Boston Healchcare System
- Lifespan Health System (Providence)
- Middlesex Hospital
- Brigham & Women's Hospital
- LINC/ABM Health Incorporated
- Massachusetts General Hospital
- Yale New Haven Hospital
- VA Greater Los Angeles Healthcare System

This program was first established in the greater Hartford area in 1974 and moved its academic affiliation to the University of Connecticut in 1996.

As part of the selection process of candidates, some applicants are invited to interview in February and March. Interviews are conducted in person at all of the hospitals offering an internship position for the next academic year. A decision on the interns selected for the next academic year is made in early April. An interview is required to secure an internship.

The internship includes a stipend for each academic year and a full tuition scholarship. Summer support is also available at many of the hospitals. Health care benefits are not included in the internship.

Dr. John Enderle is the major advisor for all Clinical Engineering Interns. Mr. Frank Painter is the Clinical Engineering Internship Director.

Application Procedure

Required in the application package for the Clinical Engineering Internship:

- Application Form (http://www.grad.uconn.edu/prospective/online.html)
- Statement of Purpose/Personal Statement describing applicant's interest in the Clinical Engineering and previous involvement in this field. Also include any other information that might be helpful for evaluation purposes
- Two letters of recommendation that are written and dated within one calendar year of the application submission
- Résumé or CV
- Official Transcripts

- GRE Scores (required for applicants that received previous degree from an institution outside of the US)
- TOEFL Scores (required for international applicants)

M.S. Degree and Curriculum

The degree awarded is either a Plan A or Plan B Master of Science in Biomedical Engineering from the University of Connecticut.

Plan A for Clinical Engineering Interns

A minimum of 15 credit hours are required and Thesis Project (9 credits of GRAD 5950).

The following courses are <u>required</u> for all Plan A Clinical Engineering Interns:

- BME 5020 - Clinical Engineering Fundamentals (3 credits)
- BME 5030 - Human Error and Medical Device Accidents (3 credits)
- BME 5040 - Medical Instrumentation in the Hospital (3 credits)
- BME 5050 - Engineering Problems in the Hospital (3 credits
- BME 6086 - Healthcare Technology Clinical Rotations I (3 credits, Spring semester, 1st year)
- GRAD 5950- Master's Thesis Research (3 credits, Fall semester, 1st year)
- GRAD 5950 - Master's Thesis Research (3 credits, Fall semester, 2nd year)
- GRAD 5950 - Master's Thesis Research (3 credits, Spring semester, 2nd year)

Clinical Engineering Interns can take more than 15 credit hours if desired. Some courses of interest include:

- BME 5500 - Clinical Instrumentation Systems
- BME 5000 - Physiological Systems I
- BME 5600 - Human Biomechanics
- BME 5700 - Introduction to Biomaterials & Tissue Engineering
- BME 5100 - Physiological Modeling
- GPAH 6305 - Program Evaluation for Health Professionals (Allied Health Sciences)
- MGMT 5675 - Strategic Management of Human Resources
- NURS 5020 - Statistical Methods in Nursing
- NURS 5860 - Organization, Systems, and Health Care Policy Leadership
- NURS 5865 - Information Systems for the Scholarship of Application

Students may enroll in other courses that match their interests and future career plans.

Clinical Engineering Interns are not required to take the BME graduate seminar or present their thesis at this seminar. Interns are required to present and publish their Master's Thesis at a conference, or have their paper accepted before graduation.

Plan B for Clinical Engineering Interns

A total of 24 credit hours are required.

The following courses are <u>required</u> for all Plan B Clinical Engineering Interns:

- BME 5020 - Clinical Engineering Fundamentals (3 credits)

- BME 5030 - Human Error and Medical Device Accidents (3 credits)
- BME 5040 - Medical Instrumentation in the Hospital (3 credits)
- BME 5050 - Engineering Problems in the Hospital (3 credits
- BME 6086 - Healthcare Technology Clinical Rotations I (3 credits, Spring semester, 1st year)
- BME 6086 - Healthcare Technology Clinical Rotations II (3 credits, Spring semester, 2nd year)

The remaining two courses can be selected from the following:

- BME 5000 - Physiological Systems I (3 credits) (Fall semester only)
- BME 5500 - Clinical Instrumentation Systems (3 credits) (Spring semester only)
- BME 5100 - Physiological Modeling (3 credits) (Spring semester only)
- BME 5600 - Human Biomechanics
- BME 5700 - Introduction to Biomaterials & Tissue Engineering
- GPAH 6305 - Program Evaluation for Health Professionals (Allied Health Sciences)
- MGMT 5675 - Strategic Management of Human Resources
- NURS 5020 - Statistical Methods in Nursing
- NURS 5860 - Organization, Systems, and Health Care Policy Leadership
- NURS 5865 - Information Systems for the Scholarship of Application

To remain a full-time student, one of these courses must be taken in the Fall semester. Students may enroll in additional courses that match their interests and future career plans. Other courses may be used to complete the required 24 credit hours if approved by the Major Advisor.

Clinical Engineering Interns are not required to take the BME graduate seminar. There are no publication requirements for Plan B MS degree students.

Master's Proposal, Project and Thesis Requirements

Please refer to the "M.S. Degree and Curriculum" section of this handbook for more information.

Timeline

The program requires that the entire two academic years be spent working at the hospital, taking courses, and working on the Master's Thesis, if applicable.

Internship Start Date, End Date, Holidays and Work Hours

Please note: Dates listed below are subject to change from year to year and are used as an example of the structure of this program.

The time commitment by the intern to the hospital is 20 hours per week. Work on the MS Thesis or the Healthcare Technology Clinical Rotations is not part of the 20 hours per week of internship.

The first day of work for the intern is one week before the beginning of the Fall semester. The last day of the year is the last day of finals. The schedule of hours worked each week by the intern are at the discretion of the hospital Clinical Engineering Director so that the intern can be included in meetings, planned work events, etc. The only time not scheduled for the internship is during class time (typically 6-9pm on one or two days a week) and travel to the class.

During the academic year, the intern's vacation schedule coincides with holidays observed in the University of Connecticut academic calendar (from August to May). If the University of Connecticut is closed for a snow day, the intern does not have to make the day up. The only vacation for interns is two weeks provided for the Christmas holidays, usually from December 18 – January 5. The time off for the Christmas holidays are decided mutually between the intern and the hospital Clinical Engineering Director. Those are the only vacations during the August to May time period. Spring break is not a holiday for the interns.

If for some reason an intern needs to take time off during the academic year, those hours missed can be made up if approved by the hospital Clinical Engineering Director. If an intern is sick, the intern may need to make up the hours missed.

Interns not working the appropriate number of hours during the internship will have their graduation delayed until all internship hours are worked. Before graduation, the hospital Clinical Engineering Director will sign off that the intern has fulfilled the number of internship hours for two academic years.

The Intern is considered part of the staff of that the hospital clinical engineering department and is expected to contribute to the function of the department by providing engineering services. The responsibilities of the intern during the first year may include some of the following:

- Assisting in the administration of the equipment management program
- Performing corrective maintenance, performance and safety Inspections and incoming inspections on specific medical equipment
- Providing in-service training for new equipment and new medical equipment users
- Analyze specific medical systems or procedures using medical technology to determine patient safety risk levels and recommend risk reduction steps
- Preparing technology assessments or product comparisons
- Providing administrative support to the Director of Clinical Engineering with budgeting and Joint Commission on Accreditation of Healthcare Organizations (JCAHO) requirements.

The intern must be aware of the vast opportunities available in the internship program. Individual initiative and drive are important. Hospital staff members are not always fully aware of a student's knowledge and background; therefore, the intern must ask questions and become involved. During this process, opportunities for learning present themselves only by proactive measures by the intern.

First Year

Plan A Students

For each of the four semesters, interns take one of the 3 credit hour clinical engineering courses (BME 5020, BME 5030, BME 5040, BME 5050). During the Spring semester of the 1st year, interns take the Healthcare Technology Clinical Rotations I course. Three credits of GRAD 5950 should be taken Fall semester of each year and Spring semester of the 2nd year to remain a full-time student.

Work on the Master's Thesis is also expected to occur during the first year by first identifying the project (a good source of a project is identifying it during the rotations, so pick the first rotations that match your interests) and conducting a background investigation.

An approved Thesis Proposal (see Master's Proposal, Project and Thesis Requirements section) is due by the end of the Fall semester of the 1st year. It should be reviewed first by the hospital Clinical Engineering Director and then by Dr. Enderle. A third BME faculty member then reviews the proposal. Progress reports are due to Dr. Enderle at the end of each month, beginning in October of the first year.

Plan B Students

For each of the four semesters, interns take one of the 3 credit hour clinical engineering courses (BME 5020, BME 5030, BME 5040, BME 5050). During the Spring semester each year, interns take the Healthcare Technology Clinical Rotations courses I and II, respectively. During the Fall semester each year, interns take one of the two other required courses.

Summer Between the First and Second Year

Plan A Students: During the summer between the 1st and 2nd years, the intern continues to work on their Master's Project.

Plan B Students

Suggest pursing additional internship experience at a hospital. See Clinical Engineering Director for suggestions.

Second Year

Plan A Students

The schedule of work is similar to the first year.

The Intern will schedule a meeting with the Thesis Committee during October. The committee will review the thesis progress.

The Intern will schedule a meeting with the Thesis Committee during March. The committee will review the thesis progress.

The Thesis defense will occur in April at a time convenient for the Thesis Committee and the hospital Clinical Engineering Director.

Plan B Students

The schedule of work is similar to the first year.

What is Expected from the Clinical Engineering Intern

- All Clinical Engineering Interns work 20 hours/week in the clinical engineering department working as if a regular employee. The hours worked during the Healthcare Technology Clinical Rotations or time spent on coursework are not counted as part of the 20 hours/week internship.

- Plan A Students will work approximately 10-20 hours/week on their thesis during the academic year. During the summer between the first and second year, the intern is expected to work 20-40 hours/week on their MS Thesis.

- All Clinical Engineering Interns work on their course requirements each semester. The usual time commitment is 10 hours/week for each course.

The hospital Clinical Engineering Director has the same job expectations of the intern as any other employee, and as such, the interns must establish a mutually agreeable schedule and follow it. Unanticipated or unexcused absences are not acceptable, unless the Clinical Engineering department rules are followed.

The interns are expected to be productive, responsible and professional members of the clinical engineering department to which they are assigned. The hospital Clinical Engineering Directors are expected to mentor them in that direction.

What to Expect from the Internship Director

The Clinical Engineering Internship Director will meet with the hospital's Clinical Engineering Director and the interns assigned at that hospital once per year to discuss important issues and current topics related to the internship program. Additional meetings may be scheduled as needed.

Each hospital Clinical Engineering Director may be asked to guest lecturer from time to time, teaching a class on material with which they are familiar. An outline of the material to be covered will be provided in advance.

The Clinical Engineering Director will meet with all of the interns for a 3-4 hour organized Internship meeting that takes place twice per semester. These internship meetings will rotate to each separate internship hospital. The hospital Clinical Engineering Director will give a 30-45 minute presentation on their career, their department, current CE challenges, department development or some other interesting topic at these meetings. Each intern at that hospital will give a 20-30 minute presentation. The Clinical Engineering Director will give a 30 minute presentation, and may ask a nearby hospital Clinical Engineering Director to give a guest presentation. The interns at that hospital will give a tour of interesting areas of their hospital.

Clinical Engineering Work Assignments in the Hospital

It is expected that the intern will be assigned to participate in the majority of the following activities at some point in their two year program.

- Establish a basic understanding of general medical equipment through 2-3 months of shadowing BMETs, performing inspections and minor repairs of a variety of devices contained in checklist of basic medical devices
- Develop new equipment inspection procedures
- Review and update/expand (if appropriate) department policy and procedures manual.
- Review / update employee job descriptions (if appropriate)
- Participate in an employee evaluation process (if appropriate – with consent)
- Prepare at least two short CE department staff in-service presentations (one per year) to teach

- Become familiar with JCAHO technology management standards and compare and comment on department practices designed to meet the standards
- Participate in department based JCAHO mock survey and participate in resolution of problems found.
- Participate in risk assessment of new technology for JCAHO inclusion
- Participate in the department's competency assurance program
- Participate in at least one HFMEA or RCA development process.
- Participate in (and eventually lead if appropriate) department performance improvement program data collection process, including among other things a customer satisfaction survey
- Accompany department director to hospital safety committee; technology selection committee; capital planning committee and other committee meetings as appropriate
- Accompany department director to one department management meeting, hospital management meeting and department director's one-on-one meeting with their administrator
- Make one presentation on behalf of the department to higher level hospital managers
- Be given the opportunity to interact with outside agencies, vendors or consultants
- Technology assessment to evaluate appropriateness of device to meet clinical need
- Evaluation of equipment for purchase including life-cycle cost analysis report, total cost of owner-ship report or new technology business plan
- Incoming inspections of new equipment or systems
- Installation of new equipment or systems (or oversee installation)
- Clinical staff in-service training program development (or oversee vendor training)
- Participate in the hospital's equipment replacement planning process
- Participate in the process to manage the CE department's website
- Participate in the development / management of the CE department's computerized medical equipment management system
- Participate in a hospital expansion / renovation project, becoming involved review of the architectural, engineering and equipment selection parts of it
- Participate (if appropriate) in development of the annual department budget.
- Review codes & standards to evaluate the department's /hospital's regulatory compliance
- Participate in the management of an extended project
- Participate in the management of recalls and alerts program
- Participate in the evaluation of several service contracts
- Participate in the investigation of at least one incident involving a medical device.

Clinical Rotations in Technology Intensive Areas of the Hospital

The following lists some areas in which clinical rotations will be performed in the clinical environment observing the clinician - patient - technology interface

- Operating Room
  - Orthopedic Surgery
  - Ophthalmic surgery
  - Cardiac surgery
  - Neurosurgery
  - Vascular surgery
  - Outpatient surgery
  - Endoscopic / laser / image guided
- Anesthesiology
  - Post-anesthesia Recovery Room
- ICU
  - Surgical ICU
  - Post Cardiac

        - Pediatric
        - Neonatal
        - Specialty (burn/neuro/….)
    - Diagnostic Imaging
        - X-ray
        - Special procedures
        - Vascular
        - Ultrasound
        - Mammography
        - Nuclear Medicine
        - Cystoscopy
        - CT
        - MRI
        - Specialty (PET/SPECT/….)
    - Laboratory
        - Chemistry
        - Hematology
        - Pathology
        - Bacteriology
        - Blood bank
    - Endoscopic gastroenterology
    - Hyperbaric medicine
    - Ophthalmology laser clinic
    - Oncology / radiation medicine
    - Emergency room
    - Clinics (in hospital & remote)
    - Homecare
    - Dialysis
    - Electrocardiography
    - Electrophysiology
    - General Medical Floor
    - General Surgical floor
    - Administration (Finance, Purchasing, Receiving, Stores, Central Supply)
    - Engineering (medical gases, electricians, HVAC, energy management)

Information Services (Networking, Software support, Help Desk, PACS, electronic patient record)

Information on Medical Institutions That Have Participated in the Program

The University of Connecticut Health Center – John Dempsey Hospital

(860) 679-2954
263 Farmington Avenue
Farmington, CT 06032
http://uchc.edu/

General Information:
SIZE: 210 beds (small)
LOCATION: Farmington, CT (10 miles west of Hartford)
PATIENT CARE: General, Surgery, Teaching

Clinical Engineering Dept. Information: The Clinical Engineering Department has 11 full-time persons. It is divided into three teams (Administrative, Hospital, and Hospital Support) each headed by a clinical engineer. All medical equipment is supported, including beds, sphygmomanometers, etc. In addition, the department supports the Clinical Laboratories as well as Radiology, which are excellent opportunities not available in most hospitals.

Responsibilities: First year students spend 20 hours per week in the Clinical Engineering Department doing electronics work, self-paced courses, reading of manuals, repairs, inspections of medical equipment, and special projects for the director. Students gain knowledge of all equipment, as the intern is paired with each engineer and technician for a period of time. All areas of the hospital are available for rotations and welcome interns, and, depending on his or her interests, the intern can determine where and how long to spend on each rotation. Second year students spend 20 hours per week in the Clinical Engineering Department. The in-tern assists the department with special projects, works on management projects including QA activities, customer satisfaction surveys, analysis of service histories, special equipment installations and more in-depth training on a wide range of health care technology. Time off for personal needs, holidays and vacations can be arranged. Students usually take vacations in accordance with the schedule of classes at the University of Connecticut.

Living Arrangements: There are no living arrangements at the hospital, though the Medical School Office has a listing of available apartments in the area.

Hartford Hospital

(860) 545-3915
80 Seymour Street
Hartford, CT 06115
http://www.harthosp.org/

General Information:
SIZE 900 beds (large)
LOCATION Downtown Hartford (south side)
PATIENT CARE General, Surgery, Trauma

Biomedical Engineering Dept. Information: The Biomedical Engineering Department consists of 28 people divided into multidisciplinary teams: Respiratory, OR, Anesthesia, Hemodialysis, Clinical Lab, Radiology & Medical Electronics. The Biomedical Engineering Department primarily provides technical support, education, research, operation and consultation to all clinical, engineering and maintenance departments throughout the hospital. Each individual department in the hospital has its own technical support personnel where required (e.g. radiology, chemistry, OR, and respiratory therapy). The intern, however, has access to all areas of engineering services and the hospital.

Responsibilities: First year students spend 20 hours per week in clinical rotations. It is the responsibility of the students to schedule these rotations and to determine the amount of time to be spent in each department. (Certain rotations are required.) All areas of the hospital are available for rotations and welcome interns. Some time is spent in the department doing repairs, inspections of medical equipment, and special projects for the director. Second year students are required to spend all time working on their project, if elected. Arrangement of tours, and interviews of prospective students are responsibilities shared with the first year in-tern. Time off for personal needs, holidays and vacations can be arranged. Students usually take vacations in accordance with the schedule of classes at the University of Connecticut.

Living Arrangements: The Educational Resource Center at Hartford Hospital has a dormitory which certain staff and Allied Health students are allowed to occupy. The clinical engineering students can rent a room on a month by month basis for the two year internship or until other living arrangements can be made. For more information contact Hartford Hospital.

Baystate Health System

(413) 794-3382
759 Chestnut Street
Springfield, MA 01199
http://baystatehealth.org/Baystate

General Information:
SIZE 780 beds (large)
LOCATION Springfield, MA (30 miles north of Hartford, CT)
PATIENT CARE General, Surgery, Trauma, Teaching

Baystate Medical Center, formerly known as Springfield Hospital, was the location for the first kidney transplant performed by Dr. James Scola on March 31, 1951. It was executed three years prior to the first ultimately successful transplant.

Clinical Engineering Dept. Information: The Clinical Engineering (CE) Department has 36 full-time persons. The department supports medical equipment, clinical systems, and imaging technology. CE is actively involved in all aspects of the medical devices and systems from pre-procurement research to disposition. The department has 12 satellite offices spread across the health system to provide service to all areas and departments. Opportunities exist for interns to work with all of the various equipment types supported by the CE department.

Responsibilities: First year students spend 20 hours per week in the Clinical Engineering Department doing reports, presentations, asset management, database management, and inspections of medical equipment. Clinical rotations are scheduled by the intern as desired with the help of the supervisors and other staff. This allows the intern to experience all different departments in the hospital and spend more time where their interests lie. The students also have an opportunity to assist in many administrative capacities by attending and participating in committee and leadership meetings. Second year students also spend 20 hours per week in the department, mostly spent working on projects. Arrangements of tours and interviews of prospective students are responsibilities shared with the first year intern. Time off for personal needs, holidays and vacations can be arranged. Students usually take vacations in accordance with the schedule of classes at the University of Connecticut.

Living Arrangements: There are no living arrangements at the hospital. Previous interns have lived in West Springfield and Chicopee in Massachusetts, while others have chosen to live in Connecticut towns such as Enfield.

VA Connecticut Healthcare System (West Haven)

(203) 932-5711, EXT. 5550

Clinical Engineering Dept.
950 Campbell Ave.
West Haven, CT 06516
http://www.connecticut.va.gov

General Information: The VA Connecticut Healthcare System is a part of VISN1 (VA New England Healthcare Sys-tem) of the 22 VISN (Veterans Integrated Service Networks) facilities nationwide.

Services: VA Connecticut Healthcare System provides specialized services for women, Geriatric Rehabilitation and Extended Care Services, hospice and respite care, pharmacy services, dental care, psychological/pastoral counseling, psycho-social support services, podiatry, prosthetics, same day surgery, alcohol and substance abuse treatment and specialized services for diabetics. In summary, VA Connecticut provides primary, secondary and tertiary care in medicine, geriatrics, neurology, psychiatry and surgery with an operating bed capacity of 170 VA Connecticut encompasses an

Inpatient facility and **Ambulatory Care Center** in **West Haven**; an **Ambulatory Care Center** of Excellence in **Newington**, and five primary care Community Based Outpatient Clinics throughout the Connecticut region.

Research and National programs: VA Connecticut conducts research in psychiatry, medicine, surgery, neurology and related basic sciences. National Veterans Health Administration programs located at VA Connecticut include the following:

- Eastern Blind Rehabilitation Center and Clinic
- Northeast Program Evaluation Center (NEPEC)
- Coordinating Center for Cooperative Studies Program
- National Virology Reference Laboratory for Tuberculosis and Other Mycobacterial Diseases
- Mental Illness Research, Education and Clinical Center (MIRECC)
- National Center for PTSD
- National Center for Research in Alcoholism and Substance Abuse
- VA/Yale Center for Neuroscience and Nerve Regeneration
- Rehabilitation Research Center for Excellence
- Clinical Epidemiology Center

Clinical Engineering Program: The Clinical Engineering services at VA Connecticut is part of the consolidated Clinical Engineering Program of VISN 1, which allows the Clinical engineering services and resources to be shared amongst the facilities within the network. The Chief of Clinical Engineering at VA Connecticut is responsible for the West Haven CT, Newington CT and Northampton VA Medical Center at Leeds MA. Currently there are 6 Tech. Stationed at the West Haven facility each having their own specialty areas e.g. Radiology, Laboratory, Specialty care units, Cardiology etc. There is one tech stationed at the Newington campus. First and second year students spend 20 hours per week in the Clinical Engineering Department doing reports, presentations, asset management, database management, and inspections of medical equipment. **The vastly diversified areas of the VA Connecticut facilities and it being part of a wide network of VA facilities in the New England region widens the horizon of opportunities to acquire and explore knowledge giving a hands on experience on virtually each aspect of healthcare.**

University of Massachusetts Memorial Medical Center (Worcester)

(508) 334-6327
Clinical Engineering Department, South 4
119 Belmont Street,
Worcester, MA 01605-2982.
http://www.umassmemorial.org

General Information:
SIZE 780 beds (large)
LOCATION Worcester, MA (40 miles west of Boston)
PATIENT CARE General, Surgery,Trauma,Teaching

Clinical Engineering Dept. Information: The Clinical Engineering Department has 21 full-time persons. It is divided into three teams (Memorial, University and Hahnemann campuses, Clinton and Health Alliance Hospitals and other satellites). All medical equipment is supported, including beds, sphygmomanometers, etc. In addition, the department supports the Clinical Laboratories as well as Radiology. The in-tern has access to all areas of engineering services and the hospital.

Responsibilities: The student spends 20 hours per week in the Clinical Engineering Department doing electronics work, reading of manuals, repairs, inspections of medical equipment, and special projects for the director. Students gain knowledge of all equipment, as the intern is paired with each engineer and technician for a period of time. All areas of the hospital are available for rotations and welcome interns, and, depending on his or her interests, the intern can determine where and how long to spend on each rotation. The intern also assists the department with special projects, works on management projects including QA activities, customer satisfaction surveys, analysis of service histories, special equipment installations and more in-depth training on a wide range of health care technology. Time off for personal needs, holidays and vacations can be arranged. Students usually take vacations in accordance with the schedule of classes at the University of Connecticut.

Living Arrangements: There are no living arrangements at the hospital. Previous intern has lived at Worcester which has colleges close to the hospital. Apartments for rent near the hospital can be found easily.

Providence VA Medical Center (Providence)

(401) 273-7100
Clinical Engineering Department
830 Chalkstone Ave.
Providence, RI 02908
Director of Clinical Engineering: Gil Pina, ext. 2096
http://www.providence.va.gov/

General information:
SIZE: 119 beds
LOCATION: Providence, RI
PATIENT CARE: General, Surgery, Teaching

The VA Connecticut Healthcare System is part of VISN1 (VA New England Healthcare System) of the 22 VISN (Veterans Integrated Service Networks) facilities nationwide.

Services:

VA Providence Healthcare System provides specialized services for geriatric rehabilitation and extended care services, hospice and respite care, pharmacy services, dental care, psychological/pastoral counseling, psycho-social support services, podiatry, prosthetics, same day surgery, alcohol and substance abuse treatment and specialized services for diabetics. In summary, VA Providence provides primary, secondary, and tertiary care in medicine, geriatrics, neurology, psychiatry, and surgery with an operating bed capacity of 119. VA Providence encompasses an Inpatient facility and Ambulatory Care Center in Providence; and five primary care Community Based Outpatient Clinics throughout Massachusetts and Rhode Island including Hyannis, New Bedford, Middletown, Martha's Vineyard, and Nantucket. Clinical Engineering Program: The Clinical Engineering services at VA Providence are part of the consolidated Clinical Engineering Program of VISN 1, which allows the Clinical engineering services and resources to be shared amongst the facilities within the network. Currently there is a Director of Clinical Engineering and 4 BMETs stationed at the Providence facility each having their own specialty areas e.g. Radiology, Laboratory, Specialty care units, Cardiology, etc. First and second year students spend 20 hours per week in the Clinical Engineering Department working with the Director of Clinical Engineering and BMETs doing reports, presentations, as-set management, database management, and inspections of medical equipment. Additionally, interns make arrangements to do clinical rotations in their areas of interest. The vastly diversified areas of the VA Providence facilities and its part of a wide network of VA facilities in the New England region widen the horizon of opportunities to acquire and explore knowledge giving a hands-on experience in virtually every aspect of healthcare.

VA Boston Healthcare System (West Roxbury)

(857) 203-5517

Clinical Engineering Dept.
1400 VFW Parkway
West Roxbury, MA 02132
Director of Clinical Engineering: Margaret Byrne, ext. 35514
http://www.boston.va.gov

General Information:
SIZE: 600 beds
LOCATIONS: West Roxbury MA, Brockton MA, Jamaica Plain MA
PATIENT CARE: General, Surgery, Teaching

The VA Boston Healthcare System (HCS) is the largest consolidated facility in VISN1 (VA New England Healthcare System) of the 22 VISN (Veterans Integrated Service Networks) facilities nationwide.

Services: With an operating bed capacity of 600, VA Boston HCS provides specialized services for women, Geriatric Rehabilitation and Extended Care Services, hospice and respite care, pharmacy services, dental care, psychological/pastoral counseling, psycho-social support services, podiatry, prosthetics, same day surgery, alcohol and substance abuse treatment and specialized services for diabetics. VA Boston encompasses acute and long term care inpatient facilities, specialty and surgical outpatient care, and four primary care Community Based Outpatient Clinics throughout Massachusetts including Boston (Causeway Street), Framingham, Lowell, and Quincy. In addition VA Boston HCS has one of the largest and most active research programs in the VA nationwide. Researchers on each of the three campuses work to provide state-of-the-art medical techniques and treatments in areas such as sleep disorders, language and memory disorders, and rehabilitation.

Clinical Engineering Program: The Clinical Engineering services at VA Boston are part of the consolidated Clinical Engineering Program of VISN 1, which allows the Clinical Engineering services and resources to be shared amongst the facilities within the network. The Chief of Clinical Engineering at VA Boston HCS is also responsible for the Bedford and Northampton VA Medical Centers. Currently there are 15 BMETs shared among the VA Boston facilities, each having their own specialty areas e.g. Radiology, Laboratory, Anesthesia, Cardiology etc. First and second year students spend 20 hours per week in the Clinical Engineering Department doing reports, presentations, asset management, project management, , and inspections of medical equipment. The vastly diversified areas of the VA Boston facilities and it being part of a wide network of VA facilities in the New England region widens the horizon of opportunities to acquire and explore knowledge giving a hands on experience on virtually each aspect of healthcare.

Lifespan Health System (Providence)

Rhode Island Hospital (RIH), The Miriam Hospital (TMH), Newport Hospital, and Emma Pendleton Bradley Hospital.

Rhode Island Hospital
593, Eddy Street
Providence, RI 02903
Shyue-Ling Chen, MS, CCE
Director of the Medical Engineering
(401)-444-4066
http://www.rhodeislandhospital.org/

General Information:
Licensed beds: RIH: 719 Bradley: 60 Newport: 129 TMH: 247 Total: 1,155
Location: Providence and Newport, RI
Patient care: General, Surgery, Trauma, Women and Infant care, Teaching
Annual revenue: $1.4 billion

Lifespan was founded in 1994 by RIH and TMH as the state's first nonprofit health care system. RIH, founded in 1863, is the designated level I trauma center in southeastern New England and is the principal teaching hospital for The Warren Alpert Medical School of Brown University.

Medical Engineering Department: The Medical Engineering Department has 29 full time employees. It is divided into three main categories: contract management, project management, and operational management. The operational management is grouped into three teams supporting general biomedical devices, the operating room, and diagnostic imaging equipment. These teams provide technical support for all of the medical devices at the Lifespan hospitals.

Responsibilities: The minimum time commitment by the intern to the hospital is 20 hours per week. The intern is stationed at the RIH, but is expected to work at the other three hospital settings as well. The primary objective of the intern is to learn all aspects of clinical engineering which includes working under the director, the clinical engineer, and the service contract manager performing various duties such as asset management, inspection and repair of medical devices, database management and also assisting the department with significant projects. A mandatory requirement is exposure in various departments through clinical rotations at the hospital.

Living arrangements: The Gerry house at Rhode Island Hospital has a dormitory. Alternative housing arrangements can be made in Providence, RI.

Middlesex Hospital

(860) 358-6054
28 Crescent Street
Middletown, CT 06457
http://middlesexhospital.org/

General Information:
SIZE 203 beds
LOCATION Middletown, CT (20 miles from Hartford)
PATIENT CARE: General, Surgery

Clinical Engineering Dept. Information: The Biomedical Engineering Department has 6 full time Biomedical Engineer Technicians and 2 full time Radiology Engineers. This department supports the medical equipment and the IT services related to the equipment. The department also oversees the RFID tracking system that is used to track the equipment throughout the hospital.

Responsibilities: The student spends 20 hours per week in the Clinical Engineering Department doing electronics work, reading of manuals, repairs, inspections of medical equipment, and special projects for the director. Students gain knowledge of all equipment, as the intern is paired with each engineer and technician for a period of time. The intern also assists the department with special projects, works on management projects, and special equipment installation. The intern will also be involved in committee meetings associated with the medical equipment. Clinical rotations can be setup with the assistance of the Clinical Engineering Director. Time off for personal needs, holidays and vacations can be arranged. Students usually take vacations in accordance with the schedule of classes at the University of Connecticut.

Living Arrangements: There are no living arrangements at the hospital. There are plenty of apartment complexes within 15 minutes from the hospital.

Brigham and Women's Hospital

(617) 732-5500 ext 28889
Clinical Engineering Department
75 Francis St,
Boston, MA 02139.
http://www.brighamandwomens.org/

General Information:
SIZE: 797 beds
LOCATION: Boston, MA (Longwood Medical Area)
PATIENT CARE: General, Surgery, Trauma, Teaching

Brigham and Women's hospital (BWH) was established in 1980 when three of Boston's Harvard teaching hospitals merged. BWH and Massachusetts General Hospital founded the Partners HealthCare System, which includes some of the hospitals and health care centers in Massachusetts. BWH encompasses the Brigham and Women's Ambulatory Care Center in Chestnut Hill and Faulkner Hospital in Jamaica Plain, in addition to other outpatient offices in the greater Boston area.

Services: BWH has five centers of excellence, which are the Dana-Farber/Brigham and Women's Cancer Center, the Carl J. and Ruth Shapiro Cardiovascular Center, the Orthopedic and Arthritis Center, the Neurosciences Institute and the Women's Health Center. BWH is a national leader in transplant surgeries. The hospitals' doctors perform heart, lung, kidney and heart-lung transplants, as well as bone marrow transplants.

Research: BWH houses laboratories and conducts clinical research studies in most of the departments. Also BWH shares core facilities that provide resources like training, materials and specimens with other Partners hospitals. The Brigham is a national leader in biomedical research. The hospital has a Biomedical Research Institute (BRI) consisting of eight research centers and four programs, allowing researchers to collaborate on health-related topics. The programs include on Biomedical Imaging, Bioinformatics, Clinical Research and Technology Innovation.

Clinical Engineering Program: There are 41 employees, including 9 clinical engineers and 22 Biomedical Engineering Technicians (BMETs), in the Biomedical Engineering Department. The department is organized into teams (oncology support, cardiovascular, medicine/surgery, and operating rooms to name a few). Each group has a team leader, a clinical engineer and several BMETs. The clinical engineering intern spends approximately 20 hours per week working on hospital projects, asset management, and inspections, repairs, and upgrades of medical equipment. Interns go to clinical rotations each week in different hospital departments to observe the clinicians using medical equipment and caring for patients.

Living Arrangements: There are no living arrangements at the hospital. Previous interns have lived in Boston and Cambridge area. Apartments for rent near the hospital can be found easily.

Massachusetts General Hospital

55 Fruit Street
Boston, MA 02114
617.724.1333
www.massgeneral.org

General Information:

SIZE:	1000 Beds
LOCATION:	Downtown Boston
PATIENT CARE:	All Major Specialties, including Cancer, Digestive Disorders, Heart Disease, Transplantation, Vascular Medicine, Obstetrics, Pediatrics and Psychology

Biomedical Engineering Department:
The MGH Biomedical Engineering Department supports the inpatient, outpatient, procedural, and perioperative areas of the hospital. Biomed consists of about 20 BEMT positions, 6 CE positions and numerous other supporting roles, including administration, database management, and model shop. The Department of Anesthesia Clinical Engineering group, which reports to Biomed, consists of about 11 BMET and 4 CE positions.

Intern Responsibilities:
Interns are expected to maintain a weekly schedule that is agreed upon by both the intern and the director at the beginning of each semester. With approval, time off is allowed, but usually coincides with the University of Connecticut breaks.

Projects include equipment upgrades and renovations, continual supporting of various systems, recalls, and product evaluation, budget proposal preparation, and others.

It is the responsibility of the intern to schedule clinical rotations. The department's assistant director will contact various departments at the beginning of the academic year. Departments are very receptive of students.

Living Arrangements and Other Information:
There are no living arrangements for interns at MGH. There are numerous apartments available for rent in the immediate Boston area or surrounding towns (http://boston.craigslist.org/aap/).
MGH is on a red line stop (http://mbta.com/schedules_and_maps/subway/).

RELATED INFORMATION

What publications will tell me more about clinical engineering?

The following is a short list of the major publications where you can find information on Clinical Engineering. Because the field is growing every day, more information is readily available.

1. *The Journal of Clinical Engineering*
2. *IEEE: Engineering in Medicine & Biology* (IEEE/EMBS)
3. *Biomedical Instrumentation & Technology* (AAMI)

For more information about these publications, contact your local Medical School Library or one of the interns.

What professional organizations will I be eligible to join?

With any profession comes obligations to continue your education and further the development of your profession. Clinical Engineering is no exception. There are a wide variety of organizations that as an intern you are eligible to join. Below is a short list of some of the more important organizations and a number to call to find more out about it.

1. AAMI (Association for the Advancement of Medical Instrumentation); 703-525-4890
2. IEEE EMBS (Institute of Electrical and Electronics Engineers, Engineering in Medicine & Biology); (908) 562-5523
3. ACCE (American College of Clinical Engineers); 610-825-6067
4. ASHE (American Society of Healthcare Engineering, part of American Hospital Association); (312) 422-3800
5. AFSMI (Association for Field Service Management International)
6. NESCE (New England Society of Clinical Engineering); 860-679-2954

The various activities of these organizations will include conferences, meetings, and critical networking to aid you in your professional career as a Clinical Engineer.

What are past interns doing today?

Most of the past interns have positions as Clinical Engineers or Directors of Clinical Engineering. Other interns go into industry and work for companies like Hewlett Packard, Eli Lilly Corp., or Medtronic Corp. Still others enter the service industry and work as a Service Representative for large companies like General Electric or Siemens. Finally, there are students that go on to medical school or pursue a PhD in a related field. In essence, the opportunities are tremendous with the internship experience and the degree.

Even though no actual recruiting takes place, most students are able to locate employment prior to graduating in May of their second year.

What has been written about this program?

The following are some articles that you may find useful as you think about this program. If you have difficulties finding them, please do not hesitate to contact one of the interns, as they will be

happy to send you a copy.

The entire issue of the May 2004 *EMB Magazine* is devoted to Clinical Engineering.

Bauld TJ. "The Definition of a Clinical Engineer." *Journal of Clinical Engineering* 1991; 16(5):403-405.

Bronzino JD. "Education of Clinical Engineers in the 1990s." *Journal of Clinical Engineering* 1990; 15(3): 185-188.

Pacela AF. "Careers 'Fact Sheets' for Clinical Engineering & Biomedical Technology." *Journal of Clinical Engineering* 1991; 16(5): 407-416.

Finally, for those with a love of statistics and a streak of greed, the *Journal of Clinical Engineering* conducts a yearly survey of the salaries and responsibilities of clinical engineers and biomedical technicians. It is very comprehensive, and is definitely worth looking at.

Clinical Engineering Internship Checklist

In order to make your transition into the Clinical Engineering Internship easier, the following checklist is provided.

1. Receive notice in mid-April regarding acceptance _____
2. Contact your future director in April and thank him or her _____
3. In mid-July start thinking about Living arrangements _____
4. In August, contact the other interns and introduce yourself _____
5. Put your apartment hunt in high gear if you haven't yet found a place _____
6. Plan on moving to the area (mid to late August) _____
7. Official start date for interns is in late August (see director) _____
8. Contact your director to notify that you are in the area _____
9. Register for classes if you haven't already done so _____
10. Start classes (late August) _____

Remember, this is only a suggested checklist. You are in no way required to adhere to it, though it does provide some important recommendations.