

# 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://www.grad.uconn.edu/>.*

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# FOREWORD

## **Dr. Donald Peterson, Biomedical Engineering Graduate Program Director**

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/>) 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: Biochemical engineering, Bioinformatics, Biomaterials, Biomechanics (Biosolids, Biofluids, Rehabilitation and Ergonomics), Bioinstrumentation, Biosignal Processing, Biosensors, Biotechnology, Clinical Engineering, Imaging and Image Processing, Molecular, Cellular and Tissue Engineering, and Physiological Modeling. The Biomedical Engineering program offers a M.S. and Ph.D. degree 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, lasers, 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>. Under the direction of faculty who are leaders in their fields with extensive government and industry sponsored research programs, along with excellent research and educational facilities, create 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 (UHC) 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, 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 (nurses) in the proper use of medical equipment. Clinical engineering, therefore, involves the application of engineering techniques to health care delivery. 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 of 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.

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 have participated in the program are as follows:

- John Dempsey Hospital (The University of Connecticut Health Center)
- Hartford Hospital
- Baystate Health System
- West Haven VA Hospital
- UMass Medical Center (Worcester)
- Providence VA Hospital
- Boston VA Hospital
- West Roxbury VA Hospital
- Rhode Island Hospital (Providence)
- Middlesex Hospital

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-biomedical Engineering degrees will need to take at least the required undergraduate Biomedical Engineering courses at the University. Students with life science undergraduate degrees must 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 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 through the Graduate School. All students interested in applying to the program should go to <http://www.grad.uconn.edu/apply.html> for more information.

Applicants are required to submit to the Graduate School:

- ❑ three letters of recommendation (preferably from members of the academic profession)
- ❑ a personal statement from the student describing their interest in biomedical engineering, indicate which of the six areas of interest you wish to pursue, and any other information that might be helpful for evaluation purposes
  - Areas of interest are:
    - **Biomaterials** (which includes Biochemical Engineering, Drug Delivery, Cellular & Tissue Engineering)
    - **Bioinformatics**
    - **Bioimaging & Bioinstrumentation** (which includes Biosignal Processing, Biosensors)
    - **Biomechanics** (which includes Biodynamics, Human Performance Engineering, Ergonomics, Cardiac Mechanics, Rehabilitation Engineering)
    - **Physiological and Biomedical Modeling** (which includes Neural Systems Engineering)
    - **Clinical Engineering**
- ❑ 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 is admitted into the Biomedical Engineering Graduate Program only if a Biomedical Engineering faculty has agreed to serve as the major advisor. **Applicants are encouraged to communicate directly with a potential major advisor at the time of the graduate application submission as well as specify a preferred major advisor on the application form.**

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 are only awarded to current 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.<sup>1</sup>

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<sup>1</sup> 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>.

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

Graduate applications are received throughout the year and processed as they are received. The Biomedical Engineering Graduate Program has rolling admissions. Therefore, students are advised to file the application for admission several months in advance of the first semester of coursework. 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 the application can be reviewed for admission. Because research assistantships are filled far in advance of the deadline for fall and spring admission, prospective students are encouraged to submit their applications for admission as early as possible. **Applications for the Clinical Engineering Internship are due by January 1<sup>st</sup>. Please see Appendix A 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 twenty-four 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 thirty credits of advanced course work, a final examination, 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 Biomedical Engineering Program Director and 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.

Under the M.S. curriculum, students must take three engineering courses and two life science courses to satisfy graduation requirements. You will work with your major advisor and advisory committee to select the core courses that fit the definitions below and are most relevant to your career goals. Definitions of core courses are:

**Life Sciences Core Courses-** To help integrate biology into your engineering experience, we require that you take at least two life science courses. Courses are typically selected from anatomy and physiology, cell and molecular biology or biophysical chemistry, but are not limited to these areas.

**Engineering Core Courses-** An engineering core course could be any engineering course offered at UConn, either in the BME Program or through another program and/or department which is extremely relevant to the student's chosen BME track and will significantly add to the graduate student's plan of study and career goals.

Examples of courses that fulfill these requirements are:

- BME 5500 Clinical Instrumentation Systems (engineering core course)
- BME 5600 Human Biomechanics (engineering core course)
- BME 5700 Biomaterials & Tissue Engineering (engineering core course)

- BME 5000 Physiological Systems I (life science core course)
- BME 5100 Physiological Modeling (life science core course)

However, students are not restricted to only take BME courses. After discussion with your major advisor and/or advisory committee, courses are selected that are deemed appropriate to fulfill graduation requirements and are in the student's area of interest. It is the responsibility of the student to keep records of core course approvals.

**Clinical Engineering Interns follow a different curriculum. Please see Appendix A for more information.**

### **Plan A**

Plan A requires no fewer than eight graduate courses (24 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 requirements can be found at <http://grad.uconn.edu/masters.html>.

### **Plan B**

The Plan B Master of Science in Biomedical Engineering requires a total of ten (10) graduate courses (30 credit hours).

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

## **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 one of whom 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/>. Typically, this includes the following sections:

- 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.

The thesis must be dated as of the calendar year in which all requirements for the degree are completed. Two high quality copies of the thesis must be deposited in the Graduate Records Office by the conferral period deadlines of August 31, December 31, or at least the Friday before Commencement. Each copy must contain an approval page bearing original signatures of all members of the advisory committee. At least 25% rag-content bond paper of at least 20-pound weight must be used for both copies. After binding, both copies become the property of the Homer Babbidge Library, and the identical second copy is made available for faculty and student use. If the thesis is

lengthy, the Babbidge Library may require that it be bound as more than one volume. Please refer to the Graduate School and Graduate Catalog (<http://catalog.grad.uconn.edu/>) for more information.

## **Final Examination**

Near the close of the candidate's period of study -- not later than one year after the completion of course work or the thesis -- the student must pass a final examination under the jurisdiction of the advisory committee. The student may not take the final examination before Regular status has been granted. The examination must be completed by the published deadlines for the appropriate conferral period for the degree to have that conferral date.

For BME M.S. Plan A, the thesis defense is used as the final exam. For BME M.S. Plan B, the final exam is based on the five core courses that the student must take.

The decision as to whether a student has passed or failed the examination rests solely with the advisory committee, which shall take into account the opinions of other participating faculty members. The vote of the advisory committee must be unanimous. Immediately following the examination, the major advisor shall communicate the results to the student and send a report on the official form to the Graduate Records Office. If the student has failed the examination or if the advisory committee considers the result of the examination inconclusive, the committee has the option of requiring the student to retake it. In such cases, the recommendation must reach the Graduate Records Office promptly, and any re-examination must take place within twelve months from the date of the original examination.

The examination may center on the candidate's research and its relation to the field of study as a whole, but may have a wider scope.

## **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/>).

## Conferral of Degrees

Degrees are conferred three times each year - August 31, December 31, and commencement day in May. 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/degree\\_completion.html](http://grad.uconn.edu/degree_completion.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, a Graduation Survey will be distributed to the students via email. This form must be returned 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://grad.uconn.edu/commencement.html> 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 may seek admission to the Biomedical Engineering Ph.D. program at the University of Connecticut. Students with a non-Biomedical Engineering B.S. engineering degrees and those with non-engineering B.S. degrees will need to take at least the required undergraduate Biomedical Engineering courses at the University of Connecticut (BME 3100, 3300, 3400, 3500, 3600W, and 3700- see the undergraduate catalog at <http://www.catalog.uconn.edu/> for course descriptions). Students with life science undergraduate degrees must 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 a M.S. degrees in areas of engineering other than biomedical engineering will 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: If students have not taken required undergraduate Biomedical Engineering courses or the five required core courses for the Biomedical Engineering M.S. (or their equivalents), completion of these courses do not count toward the Biomedical Engineering Ph.D. program degree requirements.**

A minimum of 24 credit hours, beyond the M.S., are required for the Ph.D. Additionally, 15 credit hours of GRAD 6950 “Doctoral Dissertation Research” are required.

Under the Ph.D. curriculum, students must take three engineering courses and two life science courses to satisfy graduation requirements. You will work with your major advisor and advisory committee to select the core courses that fit the definitions below and are most relevant to your career goals. Definitions of core courses are:

**Life Sciences Core Courses-** To help integrate biology into your engineering experience, we require that you take at least two life science courses. Courses are typically selected from anatomy and physiology, cell and molecular biology or biophysical chemistry, but are not limited to these areas.

**Engineering Core Courses-** An engineering core course could be any engineering course offered at UConn, either in the BME Program or through another program and/or department which is extremely relevant to the student’s chosen BME track and will significantly add to the graduate student’s plan of study and career goals.

Examples of courses that fulfill these requirements are:

- BME 6500 Bioinstrumentation I (engineering core course)
- BME 5600 Human Biomechanics (engineering core course)
- BME 5700 Biomaterials & Tissue Engineering (engineering core course)
- BME 5000 Physiological Systems I (life science core course)

- BME 5100 Physiological Modeling (life science core course)

However, students are not restricted to only take BME courses. After discussion with your major advisor and/or advisory committee, courses are selected that are deemed appropriate to fulfill graduation requirements and are in the student's area of concentration. It is the responsibility of the student to keep records of core course approvals.

## **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 24 credit hours of course work beyond the 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). Note that the journal submissions should be full papers, with two short papers being equivalent to a full paper.

## **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/>. )

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/>).

## 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/>).

## 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:

- ❑ **Objective:** The objective of this exam is to determine the student's suitability to advance to candidacy for Ph.D. studies in Biomedical Engineering. This examination seeks to evaluate a candidate's competency in basic skills and knowledge essential to conducting research in Biomedical Engineering by examining the student's grasp of material covered in the Biomedical Engineering core curriculum.
- ❑ **Who should take this exam:** All students who have been admitted to the Ph.D. program must take this exam. Failure to take the exam is equivalent to failing the exam.
- ❑ **Timing:** The qualifying exam is offered once a year, typically in the month of May.
- ❑ **Exam Contents:** The Ph.D. qualifying exam is a written and/or oral test given by the Biomedical Engineering program. This test has five parts that are based on the candidate's in depth grasp of the material in their five core courses, as determined by the advisory committee.
- ❑ **Exemptions:** Students who have passed the required core courses at the University of Connecticut with a grade of B or better may automatically pass the portion of the qualifying exam related to that course, and therefore may not need to take that part of the exam.
- ❑ **Possible outcomes:**
  1. Pass all parts: The student advances to Ph.D. candidacy and proceeds with doctoral program.
  2. Pass at least 3 parts (either through prior course work or in the qualifying exam): The student will be given the chance to take (or re-take) the courses in the failed portions of the exam within two semesters after the exam and pass these courses with a grade of B or better. Failing to do so will result in automatic termination from the Ph.D. program.

3. Pass less than 3 parts: The student will be asked to leave the Ph.D. program.

- ❑ **Qualifying Exam Administration:** The qualifying exam will be administered by a committee of five University of Connecticut faculties as assigned by the Program Director. This committee will develop clear guidelines for the students on how to prepare for the exam, will set standards for passing the exam, and will develop uniform and cohesive procedures for implementation of the examination in a manner that achieves the objectives of the qualifying exam. This committee will see to it that the results of the exam are made available to students (and their advisors) no later than 10 days after the exam day.

## Ph.D. General Examination:

- ❑ **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 been 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 (approximately 40 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/dissert.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, December, and May – 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/degree\\_completion.html](http://grad.uconn.edu/degree_completion.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://grad.uconn.edu/commencement.html> 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 15<sup>th</sup>. The first paycheck is the first pay period after the beginning of the academic year (August 23<sup>rd</sup>). Health benefits begin Oct. 1<sup>st</sup> and continue through Sept. 30<sup>th</sup> of the next year. If the forms are not received by July 15<sup>th</sup>, 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 23<sup>rd</sup>). The time schedule for spring admission follows similarly.

## 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.

Storrs Campus	Health Center (Farmington, CT)
<a href="#">Enderle, John</a>	Adams, Douglas
<a href="#">Escabi, Monty</a>	<a href="#">Bernstein, Leslie</a>
<a href="#">Faghri, Pouran</a>	Brammer, Anthony J.
<a href="#">Jain, Faquir</a>	Chapple, William
<a href="#">Javidi, Bahram</a>	<a href="#">Cherniack, Martin</a>
<a href="#">Kazerounian, Kazem</a>	Das, Dipak
<a href="#">Kumbar, Sangamesh</a>	<a href="#">Goldberg, A. Jon</a>
<a href="#">Lei, Yu</a>	<a href="#">Huber, Greg</a>
<a href="#">Liu, Lanbo</a>	<a href="#">Khan, Yusuf</a>
<a href="#">Lykotrafitis, George</a>	<a href="#">Kim, Duck</a>
<a href="#">Mandoiu, Ion</a>	Klueh, Ulrike
<a href="#">Moiseff, Andrew</a>	Kreutzer, Donald
<a href="#">Olgac, Nejat</a>	<a href="#">Kuhn, Liisa</a>
<a href="#">Read, Heather</a>	<a href="#">Laurencin, Cato</a>
Shin, Dong-Guk	<a href="#">Lieberman, Jay</a>
<a href="#">Srivastava, Ranjan</a>	<a href="#">Loew, Les</a>
<a href="#">Sun, Wei</a>	<a href="#">Mohler, William</a>
<a href="#">Wang, Yong</a>	Nair, Lakshmi Sreedharan
<a href="#">Wei, Mei</a>	<a href="#">Nukavarapu, Syam P.</a>
<a href="#">Zhu, Quing</a>	<a href="#">Oliver, Douglas</a>
	<a href="#">Peterson, Donald</a>
	<a href="#">Pilbeam, Carol</a>
	<a href="#">Sarfarazi, Mansoor</a>
	<a href="#">Simon, Richard</a>
	<a href="#">Waitzman, David</a>
	<a href="#">Warren, Nicholas</a>
	<a href="#">Wolgemuth, Charles</a>
	<a href="#">Yu, Ji</a>

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

**Bioinstrumentation & Bioimaging:**

Eisenfeld, Leonard

McIsaac, Joseph

**Clinical Engineering:**

Bronke, Jeffery

Crofts, Terry

Eisenfeld, Leonard

Jensen, Kevin

McIsaac, Joseph

Noyes, Nicholas

Painter, Frank

Stankiewicz, Henry

Subhan, Arif

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

Davis, Christian- Biomaterials, Biomechanics

Northrop, Robert- Bioinstrumentation & Bioimaging, Physiological & Biomedical Modeling

## 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, Pharmacokinetics, 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](http://www.embs.org)
- BMES (Biomedical Engineering Society); [www.bmes.org](http://www.bmes.org)
- AAMI (Association for the Advancement of Medical Instrumentation); [www.aimbe.org](http://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 has included Hartford Hospital, the University of Connecticut Medical Center, West Haven VA Hospital, UMass Medical Center, St. Francis Hospital in Hartford (Premier Inc.), Rhode Island Hospital in Providence, RI, Middlesex Memorial Hospital in Middletown, CT, and the Baystate Health System in Springfield, Massachusetts. 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, students are invited to the hospital and campus in February and March for an interview. An interview is required to secure an internship. Students selected and participating in the M.S. Clinical Engineering Internship receive a stipend during the academic year and summer support may also be available from some of the participating hospitals. Please note that a tuition waiver and health care benefits are not included in the internship.

### Application Procedure

Required in the application package for the Clinical Engineering Internship:

- Application Form (<http://grad.uconn.edu/>)
- Statement of Purpose/Personal Statement describing applicant's interest in biomedical engineering, indication of interest in the Clinical Engineering Internship, and any other information that might be helpful for evaluation purposes
- Three 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)

An interview is required before admission can be offered. Interviews are conducted in person at the hospital(s) offering an internship position.

### 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. Under the M.S. curriculum, students must take three engineering courses and two life science courses to satisfy graduation requirements. You will work with your major advisor and advisory committee to select the core courses that fit the definitions below and are most relevant to your career goals. Definitions of core courses are:

**Life Sciences Core Courses-** To help integrate biology into your engineering experience, we require that you take at least two life science courses. Courses are typically selected from anatomy and physiology, cell and molecular biology or biophysical chemistry, but are not limited to these areas.

**Engineering Core Courses-** An engineering core course could be any engineering course offered at UConn, either in the BME Program or through another program and/or department which is extremely relevant to the student's chosen BME track and will significantly add to the graduate student's plan of study and career goals.

## Plan A for Clinical Engineering Interns

A total of eight graduate courses (24 credit hours) are required and Thesis Project (9 credits of GRAD 5950). The following courses are recommended for all Clinical Engineering Interns:

- ☐ BME 5000 (310) - Physiological Systems I
- ☐ BME 5020 (350) - Clinical Engineering Fundamentals
- ☐ BME 5500 (311) - Clinical Instrumentation Systems
- ☐ BME 5050 (351) - Engineering Problems in the Hospital
- ☐ BME 5030 (352) - Human Error and Medical Device Accidents
- ☐ BME 5040 (356) - Medical Instrumentation in the Hospital<sup>2</sup>

However, students are not restricted to only take BME courses. After discussion with your major advisor and/or advisory committee, courses are selected that are deemed appropriate to fulfill graduation requirements and should be from engineering disciplines related to the intern's background, interests and future career plans. BME 5600 (Human Biomechanics), BME 5700 (Biomaterials and Tissue Engineering) and BME 5100 (Physiological Modeling) are strongly encouraged.

Most students take two classes a semester and leave the summers free to work on their Master's Thesis. Interns are expected 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 ten graduate courses (30 credit hours) are required. The following courses are recommended for all Clinical Engineering Interns doing a Plan B:

- ☐ BME 5000 (310) - Physiological Systems I
- ☐ BME 5020 (350) - Clinical Engineering Fundamentals
- ☐ BME 5500 (311) - Clinical Instrumentation Systems
- ☐ BME 5100 (315) - Physiological Modeling
- ☐ BME 5050 (351) - Engineering Problems in the Hospital
- ☐ BME 5030 (352) - Human Error and Medical Device Accidents
- ☐ BME 5040 (356) - Medical Instrumentation in the Hospital<sup>3</sup>

However, students are not restricted to only take BME courses. After discussion with your major advisor and/or advisory committee, courses are selected that are deemed appropriate to fulfill graduation requirements and should be from engineering disciplines related to the intern's background, interests and future career plans. It is the responsibility of the student to keep records of core course approvals. BME 5600 (Human Biomechanics) and BME 5700 (Biomaterials and Tissue Engineering) are strongly encouraged.

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<sup>2</sup> BME 5040 will be removed as a required Clinical Engineering Internship course beginning 2009-2010.

<sup>3</sup> BME 5040 will be removed as a required Clinical Engineering Internship course beginning 2009-2010.

Students pursuing a Plan B MS are required to take clinical rotations all four semesters rather than two semesters. 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 project.

### **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. Working more than 20 hours per week is at the discretion of the intern. The rotations through hospital departments and work on the MS thesis are not part of the 20 hours per week of internship.

The first day of the year is typically at the end of August and the last day of the year is in the middle of May. This is true for both 1<sup>st</sup> and 2<sup>nd</sup> year interns. For 2<sup>nd</sup> year interns, graduation is usually the end of the first week of May; you are still required to work as an intern 20 hours per week until the official end of the semester. 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 two days a week) and travel to the class.

During the academic year, the intern's vacation schedule usually 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 are the official holidays observed by the State of Connecticut and 2 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 and you may be expected to work that week.

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, you 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, and that the 2<sup>nd</sup> year intern will work from graduation until May 23<sup>rd</sup>.

## **First Year**

During the first year, the student works in the hospital by rotating through various departments

(such as plant engineering, emergency room, operating room, cardiac and pulmonary laboratories, etc.). He or she is considered part of the staff of that department during the rotation, and is expected to contribute to the function of the department by providing engineering services. Work on the Master's Thesis is also expected to occur during the first year by first identifying the project and then doing a background investigation (a good source of a project is identifying it during the rotations).

The rotation schedules vary among institutions, but for the most part include:

Clinical Engineering	Respiratory Therapy
Operating Room	Physical Therapy
Anesthesiology	Lab Medicine/Pathology
Emergency Room	Radiology
ICU, Adult and Neonatal	Nuclear Medicine
OB/GYN, Labor & Delivery	Radiation Oncology

These rotations are usually between two-weeks to one-month.

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.

The responsibilities of the intern during the first year may include some of the following:

- Assisting in the equipment management program by performing corrective maintenance and preventive maintenance on specific medical equipment
- Performing incoming inspections on new equipment
- Performing electrical safety testing, and medical gas outlet testing
- Providing in-services for new equipment or new medical equipment users
- 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.

### **Summer Between the First and Second Year**

Plan A Students: During the summer between the 1<sup>st</sup> and 2<sup>nd</sup> years, the intern begins work on their Master's Project. The intern works on the Thesis Proposal (details about the content of the Thesis Proposal, Thesis Project and Thesis are contained in the section —Master's Proposal, Project and Thesis Requirements). An approved Thesis Proposal is due by September 15<sup>th</sup>. It should be reviewed first by the Clinical Engineering Director at the intern's hospital and then Dr. Enderle. The third faculty member then reviews the proposal.

Plan B Students: Suggest pursuing an internship at a hospital. See Clinical Engineering Director for suggestions.

### **Second Year**

Plan A Students: The schedule of work is similar to the first year except the rotations are re-placed by work on the MS Thesis. The intern will schedule a meeting with the Thesis Committee during October. The committee will review the Thesis Proposal, Plan of Study, and general plan for the year.

Plan B Students: Student works in the hospital by rotating through various departments as in the first year.

## **Instructions for Registering for Graduate Courses for Clinical Engineering Interns**

### **1st Year Students Fall Semester:**

1. Register for courses, such as BME 5000 (Physiological Systems I), BME 5020 (Clinical Engineering Fundamentals) and GRAD 5950 (3 credit hours- Plan A students only) .
2. Get an Email Account
3. Register for courses: via on-line Peoplesoft registration.
4. Wilbur Cross Building:
  - a) Obtain Student ID from HuskyOne Card Office
  - b) Pay Tuition and Fee Bill at Office of the University Bursar

### **1st Year Students Spring Semester:**

1. Register for required Biomedical Engineering course, GRAD 5950 (3 credit hours-Plan A students only) and one course that meets professional interests or requirements.
2. Register for courses: via on-line Peoplesoft registration.
3. Pay Tuition and Fee Bill at the Office of the University Bursar in the Wilbur Cross Building

### **2nd Year Students Fall Semester:**

1. Register for required Biomedical Engineering course, GRAD 5950, (3 credit hours-Plan A students only) and one course that meets professional interests or requirements.
2. Register for courses: via on-line Peoplesoft registration.
3. Pay Tuition and Fee Bill at the Office of the University Bursar in the Wilbur Cross Building

### **2nd Year Students Spring Semester:**

1. Register for required Biomedical Engineering course(s), and one course that meets professional interests or requirements.
2. Register for courses: via on-line registration.
3. Pay Tuition and Fee Bill at the Office of the University Bursar in the Wilbur Cross Building

## **What is Expected from the Clinical Engineering Intern**

- Workings 20 hours/week as a clinical engineer in the department working as if a regular employee
  - 4-6 hours/week - clinical rotations|| in the hospital during both semesters of their first year
  - 6-10 hours/week - working on their thesis project during both semesters of their first year
  - Up to 40 hours/week - working on the MS Thesis during the summer between the first and second year
  - 20 hours/week - working on their thesis project during both semesters of their second year
  - 20 hours/week -work to satisfy university course assignments (10 hour per course) each semester

The CE directors should have the same job expectations of the interns 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 directors are expected to mentor them in that direction.

## **What to Expect from the Internship Director**

The Clinical Engineering internship director will arrange to meet with the department director and the interns at each hospital once per year to discuss important issues and current topics related to the internship program at that hospital. If additional meetings are needed they may be requested.

Each department director may be asked to guest lecturer at least once per year, 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 internship director will meet with the interns for a 3-4 hour organized Internship Meeting which will take place once per year in each separate internship hospital. We expect the hospital Clinical Engineering Director to give a 30-45 minute presentation on their career, their department, current CE challenges, department development or some other interesting topic at these meetings. We will also have each of the interns give a 20-30 minute presentation, the internship program director will give a 30 minute presentation, we may ask a nearby CE director to give a guest presentation and finally we will ask that the interns arrange for a tour of an interesting area in the 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**

- Time spent in the clinical environment observing the clinician - patient - technology interface
- Done during the first year only
- Arranged by the intern with the assistance of the second year intern, department manager or super-visor
- The intern would be the only CE person in the environment
  - 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 20 people divided into two teams: Respiratory, OR, Anesthesia & Medical Electronics. The Biomedical Engineering Department primarily provides technical support and consultation to all other 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, and respiratory therapy). The general electrical repair of monitoring equipment from the floors is handled by the Medical Electronics division of engineering services. 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. 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) 784-3382

3601 Main Street

Springfield, MA 01199

<http://baystatehealth.com/Baystate>

## General Information:

SIZE 700 beds (large)

LOCATION Springfield, MA (30 miles north of Hartford)

PATIENT CARE General, Surgery, Trauma, Teaching

**Clinical Engineering Dept. Information:** The Clinical Engineering Department has 25 full time persons and is considered large. This department supports medical equipment, as well as typewriters and paging systems. For example they do not fix beds, sphygmomanometers etc. It possesses modern test equipment as well as computer facilities. Opportunities exist to work with all equipment supported by the department.

**Responsibilities:** First year students spend 20 hours per week in the Clinical Engineering Department doing re-ports, presentations, asset management, database management, and inspections of medical equipment. Clinical rotations occur during work, depending on the schedule the intern sets up. All departments in the hospital are available for rotations and welcome interns. The students also have an opportunity to assist in many administrative capacities by participating on Medical Center Committees. Second year students spend 20 hours per week in the department, with the additional time spent working on the project. Arrangement 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 Springfield and Chicopee, while others have chosen to live closer to Hartford.

## 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 System) 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

(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

(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.

## 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.

Pacula 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.