What is biomedical engineering (BME)?
Biomedical engineering is the application of engineering principles and methods to solve problems related to the human body. Biomedical engineers work at the interface between engineering and the life sciences, applying knowledge from both areas of study to define and solve problems in biology and medicine. Students choose the biomedical engineering field to be of service to people, for the excitement of working with living systems, and to apply advanced technology to the complex problems of medical care.

What do biomedical engineering graduates do?
- Perform research and development in medical product companies
- Undertake research in laboratories of educational and medical institutions
- Evaluate the safety of medical products at government agencies
- Enter medical school to become practicing physicians
- Attend graduate school in biomedical engineering to prepare for high-level research and teaching positions

Who are the primary employers of biomedical engineers?
Well-trained biomedical engineers have skills that are invaluable to many potential employers, including and not limited to:
- Hospitals
- Rehabilitation centers
- Educational and research institutions
- Biotechnology industry
- Pharmaceutical industry
- Medical instrumentation industry
- Prosthetics and implants industry
- Environmental and public health sector
- Government regulatory agencies

Why biomedical engineering at CCNY?
The City College of New York is one of the leading public institutions in the nation with a legacy of scientific excellence, state-of-the-art research facilities, and a truly diverse student body. The Department of Biomedical Engineering includes an internationally recognized faculty conducting both basic medical research and translational biotechnology development. We are the primary engineering affiliate in the New York Center for Biomedical Engineering (NYCBE), a partnership including the premier health care and medical research institutions in New York City.

What are the educational objectives of the BME program?
The objectives of the CCNY BME undergraduate program are to prepare graduates:
1. For productive employment in biomedical and health related industry.
2. To perform successfully in graduate school, medical school or professional programs.
3. Who will ethically and responsibly apply their engineering talents for the benefit of society, demonstrating an integrated, multidisciplinary approach to problem solving.
4. Who will continue to develop technical knowledge, awareness and leadership skills that will allow them to address domestic or global problems in human health.

What kinds of courses are in the BME program?
We strive for our undergraduate students to be well-grounded in the basic engineering principles found in traditional mechanical, chemical, and electrical engineering subjects. Our program also gives students a solid background in biology and physiology and an appreciation for the complexity of living systems. Courses feature problem-solving components and vital hands-on laboratory training. The curriculum, which does not include tracks, provides both breadth and depth in biomedical engineering. Design is an important focus of the program and culminates in a two-semester senior design course, which incorporates real-world problems provided by hospital and industry partners.

A semester-by-semester course guide for the program is found on the BME curriculum sheet, which is updated every fall semester by the Grove School of Engineering Office of Undergraduate Affairs. Course descriptions can be found in The City College Undergraduate Bulletin 2009-2011, [http://www1.ccny.cuny.edu/CCNYBulletin/index.cfm](http://www1.ccny.cuny.edu/CCNYBulletin/index.cfm).
What will I know when I complete the BME program?

At graduation, each student is expected to have developed the following:

a) an understanding of biology and physiology along with the capability to apply advanced mathematics (including differential equations and statistics), science, and engineering to solve the problems at the interface of engineering and biology
b) an ability to design and conduct experiments, as well as to make measurements on, analyze and interpret data from living and non-living systems
c) an ability to design a biomedical engineering system, component, or process to meet desired needs within realistic constraints such as economic, environmental, ethical, health and safety, manufacturability, and sustainability, and addressing the problems associated with the interaction between living and non-living materials and systems
d) an ability to function on multidisciplinary teams
e) an ability to identify, formulate, and solve biomedical engineering problems
f) an understanding of professional and ethical responsibility
g) an ability to communicate effectively
h) the broad education necessary to understand the impact of biomedical engineering solutions in a global, economic, environmental, and societal context
i) a recognition of the need for, and an ability to engage in life-long learning
j) a knowledge of contemporary biomedical engineering issues
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

What are the major research areas in the BME department?

The research in BME Department is focused in 4 major areas:
- Cardiovascular Engineering
- Musculoskeletal Biomechanics
- Neural Engineering
- Nanotechnology and Biomaterials

See the CCNY BME website (http://bme.ccny.cuny.edu) or the Department’s research brochure for more info.

How can I network with other BME students, faculty, and organizations?

The BME Department holds a Town Hall Meeting every year, where students are asked to give feedback on the program to the faculty. The Department also holds a weekly BME seminar on Wednesdays at 3pm in ST-402, along with other special seminars. Every spring a BME Day is held in conjunction with the annual visit by the Department’s Advisory Board; at this event student research posters and senior design projects are presented in the lobby of Steinman Hall. The BMES student club, the national BMES (http://www.bmes.org), and BME Planet (http://www.bmeplanet.org) are also good networking sources.
Who is my BME faculty advisor?

Upon entry into the major as a freshman, each BME student is matched with a faculty advisor in the Department whose primary purpose is to: (a) help the student in selecting appropriate courses, (b) advise the student about course-load issues, (c) provide direction in the selection of specializations and technical electives, (d) offer professional development regarding career objectives, and (e) monitor student progress (which is also performed by the BME Administrative Director, Dr. Phillip Payton). All students are required to meet once each semester with their faculty advisor. Students are assigned to a faculty advisor by their last name:

<table>
<thead>
<tr>
<th>BME Faculty Advisor</th>
<th>Student Last Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. M. Vazquez</td>
<td>A</td>
</tr>
<tr>
<td>Dr. S. Kelly</td>
<td>B-C</td>
</tr>
<tr>
<td>Dr. L. Cardoso</td>
<td>D-G</td>
</tr>
<tr>
<td>Dr. S. Wang</td>
<td>H-J</td>
</tr>
<tr>
<td>Dr. S. Cowin</td>
<td>K-L</td>
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<tr>
<td>Dr. B. Fu</td>
<td>M-N</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>BME Faculty Advisor</th>
<th>Student Last Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. J. Tarbell</td>
<td>O-P</td>
</tr>
<tr>
<td>Dr. S. Nicoll</td>
<td>Q-S</td>
</tr>
<tr>
<td>Dr. M. Bikson</td>
<td>T-Z</td>
</tr>
<tr>
<td>Dr. S. Fritton</td>
<td>Students whose advisor is on sabbatical</td>
</tr>
<tr>
<td>Dr. L. Parra &amp; M Bikson</td>
<td>(check semester advising list)</td>
</tr>
<tr>
<td>Dr. M. Schaffler</td>
<td></td>
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</tbody>
</table>

Where can I get the forms needed for advising and registration?

Required forms used for registration and advising are available at the front desk in the BME main office (ST-401):
- BME Course and Advising Form (including Advisor’s List and Process)
- Independent Study Form (including Process)
- BME Curriculum Sheet

The undergraduate application to take graduate course(s) is located in the Office of Undergraduate Affairs (ST-209). If you cannot find what you need, please ask the BME Administrative Assistant, Pat Cupid, for help.

What is the advising process and how can I get the advising stop removed from my SIMS account?

To ensure that all biomedical engineering students are advised by a BME faculty advisor, an advising stop flag “EA” will be placed on each student’s SIMS record. To have the “EA” stop removed, follow the option that best represents your current status:

Students with 45 or more credits:
1. Visit your BME faculty advisor during office hours or make an appointment for a mutually convenient time. Before meeting with your advisor, fill out the “BME Course and Advising Form.” Your advisor will check over the form and sign it during the meeting.
2. Take the signed BME Course and Advising Form to Dr. Phillip Payton, the BME Administrative Director (ST-403A), who will remove the EA stop within 24-48 hours. In general, removal of EA stops will occur once a week.

Advisement process for students with 0 to 44 credits:
1. Make an appointment for advising with the Office of Student Development (212-650-8040, room ST-2M-7). Note that students with < 44 credits are strongly encouraged to meet with their BME faculty advisor before registering.

What are the requirements to change your major to BME?

It is highly recommended that all interested students meet the following requirements:
- Have a G.P.A of 3.0 and
- Completed Math 20100: Calculus-I with a grade of “B” or higher and
- Complete a 1-page essay addressing the following:
  o Your interest in biomedical engineering;
  o Your professional and academic goals;
  o Research interests.

If you meet these requirements, follow the next 5 steps:
1. Obtain a “Major Form” from your current advisor and fill it out.
2. Present Major Form and essay to BME Administrative Director, Dr. Phillip Payton, ST-403A.
3. Once signed, take Major Form to GSOE Office of Undergraduate Affairs (ST-209).
4. Submit Major Form to designee and await student copy (pink carbon.) (Major change may take approximately 1 day.)
5. Once major code has been changed to BME (major code: 176), you may obtain advising from a BME faculty advisor (if you have 45 credits or more) or register via the Office of Student Programs, 2M-7 (if you have 0-44 credits).

What are the requirements to complete the BME concentration?

Students whose primary interest is not in BME may elect to enroll in the biomedical engineering concentration. This 15-credit program is available to CCNY engineering majors in Chemical, Electrical, and Mechanical Engineering. To complete the concentration, students must take a total of five courses: two required courses (BIO 32100: Physiological Processes, and ENGR 30000: Social, Economic and Cultural Impact of Biomedical Technology) plus three courses chosen from the list of BME elective courses. See the ChE, EE, and ME curriculum sheets for details.
Can an undergraduate student take graduate-level BME courses?

Yes, but to be allowed to take a graduate course, an undergraduate student MUST:
A. Be a senior (must be currently enrolled in or completed BME 45000)
B. Have a minimum cumulative GPA of 2.75

There are three options for taking graduate courses as an undergraduate student:
1. As an Engineering or Technical Elective (credits will apply only to undergraduate degree program)
2. As a course substitution (has to be approved by BME Chair)
3. As graduate credit (credits are not needed for undergraduate degree)

To enroll in graduate courses, you must:
Step 1: Obtain a registration form from the Office of Undergraduate Affairs (ST-209) and complete Part I
Step 2: Obtain required signatures (in outlined order)
Step 3: Take completed form to Dean of Graduate Studies (ST-152) for registration. Be sure to make a copy for your records.

How should I select my electives to gain depth in an area?

While the BME program does not offer tracks, it does provide both breadth and depth in BME topics. The breakdown below demonstrates the breadth of BME topics covered in required courses, along with how elective courses can be chosen to gain depth in a particular area. Note that you must satisfy the elective course pre-requisites, so plan your electives carefully.

### Biomechanics/Biotransport

**Required Courses**
- ME 24600 Engineering Mechanics
- ME 33000 Mechanics of Materials
- CHE 34100 Transport Phenomena
- BME 50100 Cell and Tissue Mechanics
- BME 50200 Cell and Tissue Transport

**Related Elective Courses**
- ME 14500 Computer-Aided Drafting
- ME 24700 Engineering Mechanics II
- ME 32200 Computer Methods in Engineering
- ME 37100 Computer-Aided Design
- BME 18000 Bone Physiology and Biomechanics
- BME 19000 Skeletal Soft Tissue Physiology and Biomechanics
- CHE 34200 Transport Phenomena II
- CHE 51200 Pharmaceutical Applications of Chem. Engineering
- BME I4200 Organ Transport and Pharmacokinetics

### Biomedical Imaging/Signal Processing/Neural Engineering

**Required Courses**
- BME 20500 Bioelectrical Circuits with Laboratory
- BME 30500 Dynamical Systems and Modeling
- BME 40500 Biomedical Transducers and Instrumentation
- BME 50500 Image and Signal Processing in Biomedicine

**Related Elective Courses**
- BME I3000 Neural Engineering and Applied Bioelectricity
- BME I5000 Biomedical Imaging
- BME I5100 Biomedical Signal Processing
- EE 33000 Electromagnetics
- PHYS 31500 Medical Physics

### Biomaterials/Molecular Engineering/Nanotechnology

**Required Courses**
- CHEM 21000 Applied Chemistry for Biomedical Engineers
- BIO 22900 Cell and Molecular Biology
- BME 31000 Experimental Methods in BME
- BME 50300 Cell and Tissue - Biomaterial Interactions

**Related Elective Courses**
- BME 50400 Cell and Tissue Engineering
- BME 51000 Microfluidic Devices in Biotechnology
- BME G6000 Advanced Biomaterials
- BME I7000 Lab in Cellular and Molecular Engineering
- BIO 48300 Laboratory in Biotechnology
- CHE 49808 Nanomaterials
- PHYS 42200 Biophysics

How can I register for an independent study course?

Independent Study courses include:
- BME 59000: Biomedical Engineering Independent Study (3 Credits) – Engineering elective
- BME 59100: Special Project in Biomedical Engineering (1 Credit) – For qualifying transfer students (replaces ENGR 10100)

Identify the course you are interested in and discuss it with your BME advisor as well as the BME faculty member who will serve as the course instructor, who must agree to supervise you in the project. Complete the “Request for Independent Study” form, have the BME faculty member who has agreed to be the instructor sign it and place the document in a sealed envelope to be hand-delivered to:

Office of the Registrar, Willie Administration Building, A-102, Attention: Scheduling Office

Once the form has been received, the Registrar’s Office will create a special section for you so that the instructor for the course can enter your grade at the completion of the course.
Are there recent BME curriculum changes?

Yes! The BME faculty are always working to improve the curriculum, so expect changes during your time as a student at CCNY. The changes made by the faculty are reflected in the BME curriculum sheet, which is updated every fall semester by the Grove School of Engineering Office of Undergraduate Affairs. Recent changes (effective Spring 2012) relate to the choice of electives and are shown below. For the 9 credits of electives (or 11 credits for pre-med students, who take the Organic Chemistry sequence), 6 credits of Technical Electives and 3 credits of Engineering Elective are required. The most recent change (effective June 2013) was that both Phys 20800 and Math39100 are now Pre/Co-requisites of BME20500.

<table>
<thead>
<tr>
<th>Elective Course Policy Effective Spring 2012:</th>
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<tbody>
<tr>
<td>Students must complete at least 3 credits of <strong>Engineering Electives</strong> chosen from the following list:</td>
</tr>
<tr>
<td>BME 59003</td>
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<tr>
<td>BME 51000</td>
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<tr>
<td>BME 13000</td>
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<tr>
<td>BME 14200</td>
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<tr>
<td>BME 15000</td>
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<tr>
<td>BME 15100</td>
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<tr>
<td>ENGR 14200</td>
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<td>ENGR 11100</td>
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<table>
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<tr>
<th>Students must complete at least 6 credits of <strong>Technical Electives</strong> chosen from the following partial list:</th>
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<tbody>
<tr>
<td>BME 50400</td>
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<tr>
<td>BME 19300</td>
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<tr>
<td>BME 19500</td>
</tr>
<tr>
<td>BME G6000</td>
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<tr>
<td>BME 17000</td>
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<tr>
<td>BME 18000</td>
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<tr>
<td>BME 19000</td>
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<td>BIO 10200</td>
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<td>BIO 20600</td>
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<td>BIO 35000</td>
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<td>BIO 37500</td>
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<td>BIO 36400</td>
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<td>BIO 48300</td>
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<td>BIO 41000</td>
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<td>BIO 42000</td>
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<tr>
<td>BIO 42500</td>
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<tr>
<td>CHE 49808</td>
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<tr>
<td>CHE 51200</td>
</tr>
<tr>
<td>ANY course from listed Engineering Electives</td>
</tr>
</tbody>
</table>

What computational facilities and software are available to BME students?

In addition to computational facilities found around the CCNY campus, the BME department has a computer lab in Room ST-B2 with 28 desktop computers and a printer. To enter the room you need to know the key-lock combination. All machines use the same username and password. To learn the key-lock combination, username and password ask the BME front desk. Please be sure to logout and to close the door once you leave the room. The machines should all have the following software packages installed: Microsoft Office Suite, MATLAB, PSpice, Mathematica, and SolidWorks. To print you will have to bring your own paper. If any of the machines or the printer have a problem (missing software, no internet, viruses, etc.) please contact the system administrator for the B2 lab so we can fix the problem as soon as possible. His/her name and email address are posted in the room. Also, note that CCNY and CUNY have licenses to many software programs -- check their websites for details on how to obtain access to this software.

Will an operating knowledge of specific commercial software make a BME graduate more attractive to a potential employer?

The recommendation that any one particular software is a key to employment is misleading. BME graduates have the ability to learn new software without great difficulty because of their previous exposure to multiple software packages. When a potential employer advertises that a certain software experience is required for a job it is a good idea to investigate how the employer introduces new employees to their workplace. The employer may have a specific task in mind for the employee and may not provide an introductory employment period in which the new graduate could learn about the employer and acquire the specialized skills of the job for which they have been selected. It is recommended to highlight on your resume software skills you have developed to demonstrate your versatility in this area.
Are there any other important advising issues I should be aware of?

Requisites Violations: Do not register for a course unless you expect to satisfy its prerequisites before it starts or take its co-requisites at the same time as the course. If you get an insufficient grade in one of its prerequisites, drop the course. Otherwise, you will be removed from the course during the semester. Your tuition will not be refunded. If you drop below 12 credits as a result, your visa status and financial aid will be invalidated.

Engineering Courses: You can only enroll in engineering courses if you are an engineering major.

Overtalls and Registration Problems: If a course you need to take is filled, the department who runs the course may have an overtally list – go to that department and ask about it. Also, monitor SIMS closely – spots open up when students drop a course.

Always let your BME advisor know when you cannot get into a class, especially if it will affect your graduation date.

Permits: Once you are admitted into the Grove School of Engineering, it may be possible to take a course elsewhere and get credit for it; however, this will require approval of the department’s chair and the GSOE Undergraduate Dean.

Course Substitutions: If your choice of courses does not satisfy published degree requirements, you must have written permission signed by the department’s chair and the GSOE Undergraduate Dean. Verbal agreements are no guarantee—get it in writing.

Follow the BME curriculum sheet. The curriculum sheet takes precedence over what is listed in the CCNY Bulletin because it is updated more frequently.

Liberal Arts Courses: You are required to complete 18 liberal arts credits. ENGR 30000: Impact of Biomedical Technology (3 credits) is included in the 18 credits. You must select 5 courses (1 course at the 200 level or higher) from the following website: [http://www.ccny.cuny.edu/engineering/genreq.html](http://www.ccny.cuny.edu/engineering/genreq.html). Courses not found on this site will not meet the Grove School of Engineering requirement and will not meet the BME program requirements. Be sure to discuss with your advisor during advising session.

Preliminary Graduation Check: When you obtain 90 credits, you should do a preliminary graduation check one year before you apply for graduation. The Office of Undergraduate Affairs (OUA, ST-209) will provide required forms, after which you check which degree requirements you must satisfy. After submitting the application and a graduation self-evaluation, in one to two months the OUA will send you a final graduation check (academic evaluation), listing all degree requirements that have not been satisfied.

Is there a code of ethics for BME?

The national Biomedical Engineering Society (BMES) has established a code of ethics to guide biomedical engineers:

Biomedical Engineering is a learned profession that combines expertise and responsibilities in engineering, science, technology and medicine. Since public health and welfare are paramount considerations in each of these areas, biomedical engineers must uphold those principles of ethical conduct embodied in this Code in professional practice, research, patient care, and training. This Code reflects voluntary standards of professional and personal practice recommended for biomedical engineers.

Biomedical Engineering Professional Obligations

Biomedical engineers in the fulfillment of their professional engineering duties shall:

1. Use their knowledge, skills, and abilities to enhance the safety, health, and welfare of the public.
2. Strive by action, example, and influence to increase the competence, prestige, and honor of the biomedical engineering profession.

Biomedical Engineering Health Care Obligations

Biomedical engineers involved in health care activities shall:

1. Regard responsibility toward and rights of patients, including those of confidentiality and privacy, as their primary concern.
2. Consider the larger consequences of their work in regard to cost, availability, and delivery of health care.

Biomedical Engineering Research Obligations

Biomedical engineers involved in research shall:

1. Comply fully with legal, ethical, institutional, governmental, and other applicable research guidelines, respecting the rights of and exercising the responsibilities to colleagues, human and animal subjects, and the scientific and general public.
2. Publish and/or present properly credited results of research accurately and clearly.

What is the BME program’s policy regarding academic integrity?

The BME program follows CUNY’s Policy on Academic Integrity, which can be found on the CCNY website ([http://www1.ccny.cuny.edu/current/upload/Academic-Integrity-Policy.pdf](http://www1.ccny.cuny.edu/current/upload/Academic-Integrity-Policy.pdf)). In BME courses academic dishonesty (e.g., cheating, plagiarism) is not tolerated. In general, BME students are encouraged to discuss course topics and consult classmates to try to understand course concepts. However, on individual assignments and exams students must do their own work; copying from others or allowing others to copy from you is in violation of CUNY’s Policy on Academic Integrity. Plagiarism is also unacceptable, and some BME courses utilize electronic plagiarism detection software to screen for plagiarism. Academic dishonesty can have serious effects on your GPA and your status as a CCNY student.

Should a BME graduate seek registration as a professional engineer?

While many practicing BMEs probably do not encounter the need to become a registered professional engineer (PE), there are some advantages to completing the process. First, successfully completing the Fundamentals of Engineering (FE) exam, which is the first step to registration, gives the student a sense of accomplishment. Second, completing the entire process provides the student with a lifelong employment credential that entitles the person to present herself or himself as a “professional engineer” available for employment in the state in which she he is registered (many states honor professional registration in other states). At the current time, there is not a BME option for the PE exam, although this may change in the future.