

Duke

DEPARTMENT OF
Biomedical Engineering



BME Undergraduate Program Handbook



For use in the 2016-2017 Academic Year

The BME Undergraduate Program Handbook is a living document and is updated every year. It is important that students and faculty always use the latest version. Every effort has been made to ensure that it is up to date, clear, and accurate. If, however, you identify ambiguities or errors, please inform the DUS (Marc Sommer, marc.sommer@duke.edu) or ADUS (Elizabeth Bucholz, ekb@duke.edu).

Highlights of Important Changes from the 2015-2016 Version

- Clarified GWDD for December graduates: must fulfill requirements in final Fall semester, not prior Spring semester.
- Struck the “Rule of 3” that limited students to 2 majors plus 1 minor or certificate, or 1 major and 2 minors/certificates. It is no longer in effect.
- The course BME 102 (Introductory Biostatistics) has been discontinued.
- Added section on new study abroad opportunity, Duke Pratt in Costa Rica (p. 17)
- Added I&E as an approved Program for SSH electives.

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Introduction

This handbook provides an overview of the undergraduate program in Biomedical Engineering (BME) at Duke University. It covers the program mission, educational objectives, major requirements, second major options, course requirements for students planning to apply to medical school, and research opportunities.

The undergraduate major in BME at Duke University is one of the first accredited programs in the United States, and is consistently rated as one of the best BME programs in the nation. In addition, BME is the most popular major in the Pratt School of Engineering and one of the most popular undergraduate majors in the University. The student population is diverse both geographically and culturally, and is a cross-section of the very best students in the nation and from around the world. The training in the program emphasizes research and project-based learning which prepares our students with the necessary skills for successful entry into industry and professional schools (e.g., graduate school and medical school).

The members of the BME department associated with the undergraduate program are:



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Mission

The mission of the Department of Biomedical Engineering gets its foundation from Duke University. Thus, we seek to: (i) prepare our students for lives of skilled and ethical service to their communities by creating a free and open learning environment that fosters their intellectual growth, (ii) advance the frontiers of scientific inquiry, and (iii) contribute with distinction to the international community of scholarship. As biomedical engineers, our unique mission is to (a) create enabling technologies for the improvement of human health and health care and (b) create new knowledge at the interface between engineering and biomedical science.

We work closely with medical researchers to identify important problems that impact human health and solve them using our technical expertise. We engage motivated and talented students in the classroom, laboratory, and clinic, imparting to them the spirit of our mission as we prepare them for future careers as effective, knowledgeable, and ethical leaders in corporate, professional, and academic communities.

Program Educational Objectives

We expect that a few years after graduation, graduates of our program will be on track to become leaders in corporate, professional, and academic communities. In particular, they will:

- (I) advance in their careers in biomedical engineering or related areas of industry, academia, and medicine
- (II) engage in life-long learning, for example, by enrolling in graduate or professional degree programs or receiving advanced training for professional advancement
- (III) utilize their engineering experience in creating new knowledge or enabling technologies for improvement of human health and health care
- (IV) understand the social and ethical implications of their work.

Students Outcomes and Program Criteria

Our students will have the following capabilities upon completion of their degrees:

- a. an ability to apply knowledge of mathematics, science and engineering
- b. an ability to design and conduct experiments, as well as analyze and interpret data
- c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- d. an ability to function on multidisciplinary teams
- e. an ability to identify, formulate, and solve 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 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 issues
- k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

In addition, as biomedical engineers, our students will have:

1. understanding of biology and physiology
2. capability to apply advanced mathematics, science, and engineering to solve the problems at the interface of engineering and biology
3. capability to apply statistics to solve the problems at the interface of engineering and biology
4. ability to make measurements and interpret data from living systems
5. ability to address problems associated with the interaction between living and non-living materials and systems.

Accredited by the Engineering Accreditation Commission of ABET (www.abet.org)

Who's Who in BME and Pratt

This is not an exhaustive list of Duke, Pratt, and BME administrators and staff, but rather those, whom due to their position or responsibilities, you are likely to interact with as a result of pursuing a BME major.

Pratt Deans

The Dean of the Pratt School of Engineering is Dr. Ravi Bellamkonda.

The Associate Dean for Undergraduate Education is Dr. Linda Franzoni.



Ravi Bellamkonda



Linda Franzoni

There are three Assistant Deans for Advising in Pratt. Students will be assigned a Dean at the beginning of freshman year for their entire time as undergraduates.

The Assistant Dean for Advising and Outreach is Carmen Rawls.

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Carmen Rawls

The Assistant Dean for Advising and Undergraduate Research is Jim Gaston. Dean Gaston is the contact person for the Pratt Fellows program, the NAE Grand Challenge Scholars program, and the Innovation & Entrepreneurship Certificate.

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Jim Gaston

The Assistant Dean for Advising and Student Affairs is Lupita McMillian.

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Lupita McMillian

BME Administration

The Chair of the Department of Biomedical Engineering is Dr. Ashutosh Chilkoti.



Ashutosh Chilkoti

BME Laboratory Staff



Marcus Henderson

Maggie Mbugua

Matt Brown

Christine Mulvey

The BME department has a Manager of BME teaching laboratories, Marcus Henderson, and three laboratory administrators, Matt Brown, Christine Mulvey, and Maggie Mbugua. They develop our labs and keep them running smoothly and safely.

Pratt Staff

Pratt's Undergraduate Program Coordinator is Lauren Stulgis. Ms. Stulgis works with student groups (e.g., BMES and EWH), coordinates a number of programs including peer advising (i.e., E-Team) and Pratt tours, and manages [The Foundry](http://pratt.duke.edu/about/facilities/foundry)¹.

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Lauren Stulgis

The Manager of the [Pratt Student Shop](http://www.studentshop.pratt.duke.edu/)² is Steven Earp.



Steven Earp

¹ <http://pratt.duke.edu/about/facilities/foundry>

² <http://www.studentshop.pratt.duke.edu/>

Liaisons to Pratt

The liaison within the Career Center to the Pratt School of Engineering is Jennifer Agor. Jen provides career advising for STEM undergraduates and hosts career skills workshops and industry programming in these fields and also conducts mock interviews.

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Jen Agor

The liaison within Duke University Libraries to the Pratt School of Engineering is Melanie Sturgeon.

[Undergraduate Library Services](http://library.duke.edu/services/undergraduate)³



Melanie Sturgeon

³ <http://library.duke.edu/services/undergraduate>
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Pratt School of Engineering and BME Major Requirements

As a program accredited by the Accreditation Board of Engineering and Technology (ABET, <http://www.abet.org>), the BME curricula must satisfy minimum requirements in mathematics, sciences, and engineering. In addition, the Pratt School of Engineering has requirements for all engineering students. To meet these constraints, the Department of Biomedical Engineering has developed specific requirements for undergraduate students. Samples of curricula for students with different BME-related major choices are provided in Tables 1-4. In summary, BME students need to take the courses listed below.

Two Life Science Courses and Physiology Requirement

Biology 201L and BME 244L, Quantitative Physiology with Biostatistical Applications, are required for all BME single or second majors. BME majors are expected to choose Life Science electives from Table 7. These courses have been approved by the BME Curriculum Committee as having sufficient rigor and relevance to biomedical engineering. Students can request approval for courses not on these lists to count as a Life Science elective. The course must be (i) non-introductory (generally meaning that it is at the 200-level or higher and has Biology or Chemistry prerequisites), (ii) quantitative (involves mathematical analysis at some level), and (iii) related to physiology. Approvals are rare, although occasionally new courses are offered at Duke that meet these criteria even though they are not yet listed in Table 7 list. We are always interested in evaluating such courses. Students wishing to petition for approval of a course can send their request to the BME DUS with a short explanation of their interest in the course, a detailed course syllabus listing the topics covered, and a prerequisite list.

Two Chemistry Courses

Students are required to have two chemistry courses:

- (Chem 101DL **or** Chem 110DL) + (Chem 210DL **or** Chem 201DL)

Chem 21 (AP=5) replaces Chem 101DL/Chem 110DL. Chem 20 (AP=4) is not accepted by BME.

AP credit in chemistry options:

- Chem 21 (AP=5): must take Chem 210DL **or** Chem 201DL

Common questions about Chemistry placement are answered here:

<http://chem.duke.edu/undergraduate/placement-guidelines>

Two Physics Courses

Students are required to have two physics courses:

- Physics 151L + Physics 152L
- Physics 161L + Physics 162L

One physics course **MUST** be taken post-matriculation, regardless of AP credit.

AP credit in Physics options:

- No AP credit or AP<4: must take Physics 151L **and** Physics 152L
- Physics 25 (AP=4,5 on Physics C Mech) *only*: must take Physics 152L
- Physics 26 (AP=4,5 on Physics C E&M) *only*: must take Physics 151L
- Physics 25 *and* Physics 26: must take Physics 153L or 264 or 361 or 362

Students may not take Physics 151L at Duke and use AP credit for Physics 152L unless the student has Physics 26 credit only.

Five Mathematics Courses

All BME majors must take:

Math 111L, Math 112L, Math 212, Math 216, and Math 353

AP credit [Math 21] is accepted in place of Math 111L and AP credit [Math 22] is accepted in place of 112L. Starting with the matriculating class of 2016 (graduating class of 2020), the Math department changed its AP math policies. Common questions about mathematics placement are answered here: <http://math.duke.edu/courses/placement>. Transfer credits are examined on an individual basis.

AP credit options for the first two Math courses:

- No AP or AB AP credit <5, BC AP credit <4: must take Math 111L **and** 112L
- AB AP=5 or BC AP=4: must take Math 122L in the fall
- BC AP=5: may proceed to Math 212

If students are advised by the Math department to skip any courses in the Math sequence listed above, *they must replace those courses with additional Math courses approved by the BME DUS. The total number of Math courses taken at Duke plus the number of AP or transfer credits must equal 5.*

BME/Math majors: Students wishing to complete Math as a second major will need to take:

Math 111L, 112L, [212 or 222], 221, and 356

Math 221 + 356 substitutes for 216 and 353. *Once students start the BME/Math sequence by taking Math 221, they must complete it. They cannot switch to the regular BME sequence.*

Digital Computation and Computer Programming

All engineering students must take EGR 103L to meet this requirement. Students with ECE as a second major must also take CompSci 201.

Five Social Sciences and Humanities (SSH) Courses

The specific requirements are as follows:

- At least one course must be a social science (SS).
- Other courses must be selected from at least two of the following three areas: arts, literature, and performance (ALP), civilization (CZ), and foreign language (FL).
- At least two courses must be taken from the same *department* with one being at 200-level or higher. AP credits with 200-level numbers do not count as an upper-level course toward this requirement.
- Skill courses cannot be used to fulfill the SSH requirements except full-credit foreign language courses with an area code.
- A maximum of two AP credits is accepted in place of the SSH requirements.
- SSH courses taken in an engineering, science, or other department not listed in Table 8 (e.g., Chemistry, Global Health) count only if they are cross-listed in an approved SSH department. The list of allowed SSH departments and programs is posted on <http://www.pratt.duke.edu/undergrad/policies/3505> and is also listed on Table 8 of this handbook.

AP credits do not carry course codes, however, in the Pratt School of Engineering Areas of Knowledge are attributed to AP exams. Some examples include: History (CZ), Psychology (SS), Political Science (SS), Language courses (FL), English (ALP), Economics (SS), and Music (ALP). Consult your Dean if you have a question about AP credit.

One Undergraduate Writing Course

Academic Writing 101 is required.

Courses for the BME Major

Required Courses⁴

For students in the BME major, the following ten courses are required: EGR 201L, ME 221L, BME 244L, BME 260L, ECE 110L, BME 271 **or** ECE 280L, BME 354L, two BME Area Core Classes and a BME design course.

Important: BME Area Core Classes are **not** offered in the fall semester. Thus, these courses must be taken in the spring semester of your junior year in order to graduate on time. Students should go abroad no later than the fall of their junior year. It will be EXTREMELY difficult to go abroad for spring semester of your junior year and still graduate on time.

The two Area Core Classes are chosen from the following four areas (see also Table 5):

<u>Area</u>	<u>Core Class</u>
BB (Biomechanics and Biomaterials)	BME 302L Fund. Biomaterials and Biomechanics
EL (Electrobiology)	BME 301L Bioelectricity
IM (Imaging and Measurement Systems)	BME 303 Modern Diagnostic Imaging Systems
MC (Molecular, Cellular and Tissue Egr.)	BME 307 Transport Phenom. in Biological Systems

The design course can be chosen from the following list:

- BME 432L Biomechanics and Vehicle Safety Engineering (typically offered in fall)
- BME 436L Biophotonics Instrumentation (typically offered in spring)
- BME 460L Devices for People with Disabilities (typically offered every term)
- BME 462L Design for the Developing World (typically offered every term)
- BME 464L Medical Instrument Design (typically offered in fall)
- BME 490L Special Topics in Biomedical Engineering Design (offered occasionally)

BME Electives

Students take elective courses to learn advanced knowledge in specific areas of biomedical engineering. More than fifty BME electives have been developed, but the courses offered in any given semester depend on the availability of faculty. BME majors must take 4 BME Electives, distributed as described next.

For matriculating classes of 2014 and earlier (graduating classes of 2018 and earlier): To ensure depth in at least one area of Biomedical Engineering, you must take two *Area* Electives within the same area as one of the Area Core Courses you have taken. In addition, BME majors must take two BME *General* Electives.

For second majors, the distribution of BME Area and General Electives required depends on the first major (see Tables 2-4). Table 5 provides the current list of the Area Electives. Table 6 provides area designations of Special Topic courses, BME 290 and 590.

BME General Electives can be any full-credit, regular-graded BME course for which you have the prerequisites and which is not a required course for your major. Two semesters of Independent Study courses can be counted as two General Electives. Please note undergraduates are not allowed to take courses level 600 and above.

⁴ ECE, ME, and CEE as a second major: please consult Tables 2-4.
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For the matriculating class of 2015 and later (graduating class of 2019 and later): You will still take a total of four BME Electives, as was the case for previous matriculating classes, but three of these must be 'Advanced' Electives, two of which must have the same Area of Focus as one of the Area Core Courses you have taken. The 4th BME Elective can be a BME *General* elective, although an Advanced Elective would count as well. That is, your distribution of BME Electives would be as follows:

- 1-2. Two Advanced Electives in same Area of Focus as one of your Area Core Courses
3. Another Advanced Elective
4. A General or Advanced Elective

All BME Electives will be labeled as Advanced Electives (AE) or General Electives (GE) based on their engineering content as evaluated by the BME Department's Curriculum Committee. Most of the Advanced Electives will also have an Area of Focus designation (BB, IM, EL, or MC). Independent Study courses will count as BME Advanced Electives (without an Area of Focus), and thus one semester of Independent Study will count for item 3 in the list above and two semesters will count for items 3 and 4 in the list above. Please note undergraduates are not allowed to take courses 600 level and higher.

Unrestricted Electives

At most, two unrestricted ("free") elective course credits will be counted. The final number depends on the major choice (see Tables 1-4). Only unrestricted electives can be .5 credit courses and can be taken on the Satisfactory/Unsatisfactory basis.

Note on Statistics

A statistics course is not required for BME majors and BME/ME majors. Students with a second major in ECE must take Stat 130 or Math 230 or ECE 380 or ECE 555; CEE second majors must take Stat 130 or equivalent.

Note on AP credit

If AP credit is used to meet a prerequisite for a course and that course is successfully completed, then any Duke course that is equivalent to that AP credit may not be taken (i.e., the AP credit may not be waived).

Consider the following example. AP credit for Physics 26 has a Duke equivalent of Physics 152L. Physics 152L is a prerequisite for BME 354L. A student who has utilized their AP credit for Physics 26 to gain enrollment in BME 354L cannot enroll in Physics 152L after successfully completing BME 354L.

Independent Study and Pratt Fellows Program

Independent study is an integral and immensely popular component of the undergraduate education at Duke. **One or two** such courses (during junior and senior years only) can be counted as BME General Electives [BME 394, BME 493, and 494] for matriculating classes of 2014 and earlier, or as Advanced Electives for matriculating classes of 2015 and later. This number depends on the major choice; it is two for BME sole majors but may be one for BME dual majors (see Tables 1-4).

A research experience can be achieved in one of three ways:

- Perform directed BME research with a BME faculty member as a project supervisor and receive BME Elective credits [BME 394, BME 493 and/or 494].
- Perform directed BME research with a non-BME faculty member (for instance, a clinician). In such cases, the project must be sponsored by a BME faculty member. The sponsor is responsible

for evaluating the quality of the project and student's performance. Some students choose to perform sponsored *BME research* in the Duke Smart Home Program (for details, check the website at <http://smarthome.duke.edu/>).

- Apply for a Pratt Research Fellow position during your junior year (to learn more, check <http://www.pratt.duke.edu/undergrad/students/research-fellows>). Pratt Research Fellows perform research in a BME faculty's lab for three academic semesters plus a full summer term and receive two BME Elective credits [BME 493 and 494].

Independent study in the summer or while abroad is not allowed unless the project supervisor obtains special permission from the BME DUS.

To register for a BME independent study course, the students should:

1. Find a project supervisor.
2. If the project supervisor is not a BME faculty (i.e., he/she is not listed on the BME Web page), find a BME faculty who will sponsor your independent study.
3. Fill the "BME Independent Study Request" form, which is posted on <http://www.bme.duke.edu/undergrad/independent-study>. Consult with the project supervisor about project title, description, biomedical area, engineering content, the nature of final product, and grading basis.
4. Request approvals from the project supervisor, BME sponsor (if required), and the BME DUS.
5. After all approvals have been granted, the DUSA in the BME office will generate a section of BME 394, 493, or 494 for the student and issue the permission number to register.

Freshmen and sophomores: Your independent study can only count as an unrestricted (free) elective. The registration is handled by the Dean's office (not the BME department), where you obtain the permission number to register for EGR 391 or 491.

Graduation with Departmental Distinction

Graduation with Departmental Distinction (GWDD) award is presented to the Pratt Students who, in the opinion of the BME department and a committee of the faculty, have demonstrated exceptional achievement by maintaining a high grade point average, conducting independent research in the area of their special interest, and presenting results of their research in a write-up and at a poster presentation. This award is open only to students whose first major is Biomedical Engineering. Students who graduate in September should present their research posters in April in the year prior to graduation. Students who graduate in December need to fulfill their requirements in their final Fall semester; a special poster session will be held just prior to Thanksgiving break.

For graduation with distinction in BME, the students should:

1. Have a grade point average of 3.5 or higher at graduation.
2. Complete BME 493 or 494 course in their senior year through either an Independent Study or the Pratt Research Fellow Program.
3. Complete an original and independent research project under a BME faculty supervision or sponsorship.
 - A project from an Independent Study course does not automatically qualify for the graduation with distinction.
 - Group projects in general do not qualify unless there is a clear delineation of the work the student performed.
 - The project must have biomedical engineering content.

Students should speak to their project supervisors to determine the suitability of the project.

4. Select an examination committee consisting of three faculty members. Two of the members must be the primary BME faculty; project supervisor and BME sponsor usually serve on the committee.

5. Submit “Application for Graduation with Distinction” form, approved by the project supervisor. The form is posted on <http://www.bme.duke.edu/undergrad/graduation-departmental-distinction-bme>. The application must be submitted by the deadline (usually mid-April, or for December graduates, mid-November; the DUS will provide specific dates).
6. Submit a write-up describing the problem considered, methods used, results obtained, and their significance. This document should emphasize biomedical engineering content of the project.
 - The maximum length is one page (single space, 11-point Times New Roman, two columns).
 - The student should be listed as the first author; project supervisor and, if applicable, BME sponsor as co-authors.
 - The Acknowledgement section should state contributions to the project made by other individuals.
7. Prepare a poster and present it at the BME Graduation with Distinction poster session. The committee members and other BME faculty will view each poster and ask questions concerning the research. This is a formal defense of students’ work. Poster session is held late in the semester, usually on Thursday, 12-2 pm.
8. Graduation with distinction is awarded when *all* committee members vote in favor.

Preparation for Medical and Dental Schools

Students planning to attend medical and dental schools should read the information provided on the Office of Health Professions Advising website (<http://prehealth.duke.edu>) and consult with their prehealth advisor (<http://prehealth.duke.edu/advisor>). The Health Professions Advising Office provides advice to students planning careers in several health professions and also information on the application process, degree requirements, research and volunteer opportunities. *While the information below is correct at the time of this publication, all prehealth students should periodically review information on requirements as these may change from year to year and school to school.*

Pratt students planning to apply to medical and dental schools should plan to complete the following courses:

Subject	Duke Courses	BME curriculum
Chemistry <i>4 semesters with lab</i>	Chem 101DL or 110DL or 21 (AP)	required
	Chem 201DL	required
	Chem 202L	free elective
	Chem 210DL ¹	free elective/extra class
Biochem ² <i>1 semester</i>	Biochem 301	LS elective
Biology ³ <i>2 semesters with lab</i>	Molecular: Bio 201L	required
	Physiology: BME 244L	required
	Genetics: Bio 202L (optional)	free elective/extra class
Physics ⁴ <i>2 semesters with lab</i>	Phys 151L or 25 (AP)	required
	Phys 152L or 26 (AP)	required
	Phys 153L if AP credit for 25 and 26	extra class
English <i>2 semesters</i>	Academic Writing 101	required
	English course or English AP credit	SSH elective
Behav Sci ⁵	Psy 101 and/or Soc 110 are recommended	SSH elective
Statistics ⁶	none or AP credit or BME 102 or Stat 130	extra class

¹ Chem 210DL is required for some Pratt students and optional for others. Students who have no AP credit in chemistry should take Chem 210DL to complete their four semesters of chemistry.

Students with AP credit (Chem 20 or 21) and who enroll in Chem 110DL do not need to take Chem 210DL, as they will show medical schools four semesters of chemistry (AP, 110DL, 201DL, 202L). However, students with AP credit (Chem 20 or 21) and who enroll in Chem 101DL should consider enrolling in Chem 210DL. While they will have four semesters of chemistry (AP, 101DL, 201DL, 202L), the chemistry department recommends that any student who enrolls in Chem 101DL also continue on to Chem 210DL so their knowledge of inorganic chemistry is complete.

Students with AP credit (Chem 21) and who go directly into organic chemistry generally do not need to take Chem 210DL. The addition of biochemistry (Biochem 301) gives them four semesters of chemistry (AP, 201DL, 202L, Biochem 301). However, with the changing MCAT and the new requirement for biochemistry, it is possible that a few medical schools may consider biochemistry a

separate requirement, and thus ask for another semester of chemistry. There are also a few medical schools that do not accept AP credits or will ask for more advanced coursework. In these instances, a student could add Chem 210DL or Biochem 302 or Biochem 401 in their junior or senior year in order to provide an extra semester of chemistry. See the prehealth website for more details.

<http://prehealth.duke.edu/prepare/course-requirements/ap-ipc-credits-and-course-choices>

² Biochemistry has been included in the MCAT since 2015, so premed students should enroll in Biochem 301. Note that many dental schools also require a semester of biochemistry. Biochem 301 is offered in the fall and summer session I, but not in the spring.

³ BME 244L is required for matriculating classes of 2011 and after. This course and Biology 201L serve as the two biology-lab courses required for medical school. BME 244L also covers physiology and statistics for the MCAT. Biology 202L is recommended but optional; if this course is not taken, a student should self-study genetics for the MCAT.

⁴ Note that Physics 151L and 152L do not cover all the material on the MCAT exam and some self-study is required; or alternatively, Physics 153L can be taken. Phys 153L is recommended for students who have AP credit for Physics 25 and 26.

⁵ Psychology 101 (or AP) and Sociology 110 are recommended for the new MCAT. Students might choose to take alternative psychology or sociology courses or self-study depending upon their background. Students should confer with their prehealth advisor on this.

⁶ Statistics has been incorporated into BME courses since 2011; this should be sufficient preparation for the MCAT. Few medical schools currently require statistics. However, if students need an additional statistics course, BME 102 or Stat 130 is recommended as an extra class. Note that BME 102 can be taken only in the freshman year.

As seen in the above table, many courses satisfy the requirements for both the BME major and the entrance to medical and dental schools. Examples of schedules for premed and BME are shown in Tables 1b, d, and f. Students should take the MCAT once they have completed the required courses. Students can choose to apply to medical/dental school immediately after taking the MCAT or postpone application for a maximum of 3 years. Students should discuss the timing of the MCAT and their application with their prehealth advisor.

Second Major, Minor, and Certificate Programs

Students can declare a second major within the Pratt School of Engineering. For these students, the required courses are listed in Tables 2-4. Minors and certificates are also offered by Pratt (a certificate is similar to a minor but offered for interdisciplinary study). Opportunities also exist for students to combine the BME major with a second major, minor, or certificate from the Trinity College. To do so, the students must meet the same requirements as those for BME single major plus the specific requirements from other departments or programs as outlined in the Bulletin of Undergraduate Instruction (<http://registrar.duke.edu/university-bulletins/undergraduate-instruction>). These requirements usually consist of ≥ 10 courses for a second major, 5 courses for a minor, and ≥ 6 courses for a certificate. Hence, this is usually possible only if a student matriculates with AP credits. To reduce the work load for obtaining the second major, minor, or certificate in the Trinity College during the regular academic semesters, students can either take the required Trinity courses as unrestricted electives in the BME curriculum or take them in the summer.

Double Counting Courses: Some of the courses can be double counted toward both the BME degree and the second major, minor or certificate in the Trinity College. For example, two courses required for the second major in Economics may be counted as two of the five SSH courses required for the

BME degree. Note however that some departments and programs (e.g., Neuroscience) impose limits on double counting.

When planning for the second major, minor, or certificate, students should *not* base their programs on the assumption that they will be able to take a specific elective course (for example, BME 385 that can be double counted toward BME and Economics) in a specific semester. An elective course may or may not be offered or the student may not be able to take it for a number of reasons (conflicts, class full, no consent from the instructor etc.).

Cross-Listed Versus Paired Courses: Both cross-listed and paired courses are taught by the same instructor at the same time. The difference is that a cross-listed course can be counted as any of its cross-listed components. Paired courses count only as the course for which the student has registered. For example, Physics 414 and Biology 418 are cross-listed; a student who has taken Physics 414 can count this class as Biology 418, a Life Science elective. In contrast, BME 567 and Chemistry 601 are paired: it means that BME 567 counts toward BME major only and Chemistry 601 counts toward Chemistry major only; it cannot be counted for both. Students need to pay attention for which course they register because paired courses are difficult to change once the add/drop period is over.

Declaring a second major: Use the same declaration form that is used to declare primary majors, <http://www.pratt.duke.edu/forms/declaration-of-major>.

Sample Curricula and AP Credits

Tables 1-4 provide samples of curricula for BME majors, BME majors considering Medical School, and Second majors. Common adjustments to these sample schedules include:

- Students with AP credits for Math 21 should take Math 122L in the fall and Math 212 in the spring of their freshman year. This will eliminate a 5-course semester in the fall of sophomore year.
- Students with AP credits for Physics 25 should take Chem 210DL or Chem 201DL in the spring of their freshman year. This will eliminate a 5-course semester in the spring of sophomore year.
- Students with AP credits for Math 21 and Physics 25 who are considering Medical School should move Math 122L and 212 as described above, take Chem 201DL in the spring of their freshman year, and Chem 202L in the fall of their sophomore year. This will eliminate 5-course semesters in the sophomore year.
- Students with AP credits for Chem 21 who do not take Chem 101DL or 110DL should take Biology 201L in the fall of their freshman year and Chem 210DL or Chem 201DL in the spring of their freshman year.

Planning for Study Abroad

Students interested in participating in the Global Education program need to develop an academic plan with their advisors several semesters in advance. This plan includes the courses to be taken in foreign countries and the remaining courses to be taken at Duke before and after the semester abroad. Students intending to study abroad should plan to travel in the *fall semester of their junior year*. Directors of Academic Engagement offer one-on-one appointments to consult about global and civic opportunities: <https://advising.duke.edu/dae>.

Students may receive equivalent Duke credit for courses taken at universities outside of the US. These equivalencies must be approved before a student can receive credit. The Duke Global Education office maintains a list of courses which have already been designated as Duke equivalents: <https://courses.globaled.duke.edu>. These are the easiest courses to take, as no special approvals are required for transferring them to Duke.

A course which does not already appear on the Study Abroad list may still be transferred, if the student obtains an individual approval from the department that awards its Duke equivalent. For example, the history department DUS would approve a course that a student wishes to transfer as a history course. Obtaining these equivalency approvals can be difficult and time consuming. Students are advised to begin the approval process several months *before* departure. For BME courses, students must inquire first with the BME Study Abroad advisor, Dr. Chelsea Salinas (chelsea.salinas@duke.edu). If she determines that course approval is feasible, students must then submit requests for course approval to the BME DUS. The process for approval of courses in the study abroad program is the same as that used for all transfer courses.



Chelsea Salinas

Currently, very few of the required BME courses are offered abroad. Typically, students receive credit for BME 271, Social Sciences and Humanities electives, Life Science elective, and/or BME General Elective. A few places also offer a course equivalent to ME 221L. Therefore, the following courses should be taken before the semester abroad:

- BME 260L; it is a prerequisite for BME 307, an Area Core course for Molecular, Cellular, and Tissue Engineering.
- ME 221L — unless it is offered abroad. This course is a prerequisite for BME 302L, an Area Core course for Biomechanics and Biomaterials. Note that EGR 201L is a prerequisite for ME 221L, so it should be taken in the fall of your sophomore year.
- Math 353, which is also a prerequisite for BME 302L.
- BME 271 — if not taken abroad. It is a prerequisite for BME 354L and BME 303, an Area Core course for Imaging and Measurement Systems.

Duke Pratt in Costa Rica

Because it is often challenging for Duke BME students to coordinate their schedules in order to participate in traditional Study Abroad programs, Pratt is inaugurating a new opportunity in the summer of 2017: [Duke Pratt in Costa Rica](#) (see also <https://bme.duke.edu/about/news/61030>). It is part of the Duke-in study abroad program, meaning that the courses will be Duke courses taught by Duke faculty. Students will take either BME 271/ECE 280 or Math 353, plus a required course on Spanish language and culture (Spanish 92A).

4 + 1 BSE/Master's Program (Five-Year Combined Bachelor/Master Degree Program)

The program offers a five-year combined Bachelor of Science and master's degree. This is a great opportunity for students who want to broaden their undergraduate research experience or to obtain advanced training in biomedical engineering or management.

Currently, the following three options are available:

- BSE + Master of Science
- BSE + Master of Engineering

- BSE + Master of Engineering Management

For more information about each of these options, consult links posted on the page <http://www.pratt.duke.edu/undergrad/degree-programs/bse-masters>), the BME Director of Master's Studies, or the directors of individual master's programs.

To complete both Bachelor's and Master's degrees in five years:

- Meet with your academic advisor to develop a course plan for your senior year that leaves room for graduate-level courses.
- Apply for admission to the master's program of your choice. The applications process and deadlines differ between the programs; to find applicable information, follow links on <http://www.pratt.duke.edu/undergrad/degree-programs/bse-masters>). In general, you should develop a plan and apply in the fall of your senior year.

Advising

Assignment of BME advisors: Due to the high student/faculty ratio in the BME program, freshmen might not be assigned to BME faculty. Regardless, students will be assigned to a BME advisor after declaring a BME major or a BME dual major with BME as the primary department. Students can declare majors or change them at any time after their freshman year. To do this, the students complete an online form:

<http://www.pratt.duke.edu/forms/declaration-of-major>.

The assignment of faculty advisors is based upon the major interests (e.g., BME with ECE as a second major) expressed by the students and the need to balance the number of advisees per faculty. Currently, each BME faculty member advises an average of twenty students. The name and email of academic advisors are listed in students' records on ACES; students should check it before making an appointment. The address of BME website for making an online appointment is <http://advising.egr.duke.edu>. If your advisor isn't listed at the Pratt advising site, you can send your advisor an email directly to schedule a meeting with them.

Some students' advisors may not be available in a given semester for various reasons (e.g., faculty on sabbatical). These students will be informed of the situation and directed to make their advising appointments with the DUS or Associate DUS.

Resources available to freshmen: First-year students interested in BME have additional means of obtaining information specific to BME curriculum and requirements:

- In Fall semester, a series of evening Departmental Information sessions are offered by Pratt. The BME DUS and ADUS provide information regarding the profession and details about the program and the course of study. All students interested in BME are encouraged to attend.
- Students should examine the BME Undergraduate Program Handbook, which is posted on the departmental website and which describes all requirements for the BME major.

Pre-registration advising of BME students: Students meet with their advisors during the pre-registration period in March/April for the fall semester and in October/November for the spring semester. The advisor reviews the student's academic report, discusses with the student the courses that he or she will take in the following semester. The student is responsible for informing the advisor of any changes in the plan.

Career advising: Students can discuss their career plans with their advisors. In addition, advisors can help students to identify specific sequences of courses or dual major options that are most appropriate for them. The BME department encourages students to seek out the resources of the Duke Career Center, which can be found at: <http://studentaffairs.duke.edu/career>. Jen Agor, who is the designated STEM career advisor, can be found here: <https://studentaffairs.duke.edu/career/about-us/staff/jen-agor>.

Information on Internship, Co-Op, Employment, and Graduate School Opportunities

Information on internship, co-op, and employment opportunities is posted on the website of the Duke University Career Center: <http://www.studentaffairs.duke.edu/career>. In addition to maintaining the websites mentioned above, the Career Center organizes various career-related activities. These include (a) career advice sessions, (b) industrial interview events, (c) graduate school recruiting events, and (d) workshops and seminars on internship, co-op, and employment that are specific for engineering or BME students. The workshops and seminars are announced via emails and posted on the TV monitors in the engineering buildings. The Career Center is located in Smith Warehouse at 114 S. Buchanan Blvd, Bay 5. In addition to the Career Center, Kirsten Shaw (Kirsten.shaw@duke.edu, 919-660-5533), Associate Director of Corporate Relations in the Pratt School of Engineering, helps Pratt students connect with corporations for internship opportunities. Her office is located at 424 Teer. For more information, see <https://pratt.duke.edu/undergrad/students/internships>.

Information on internships, co-ops, employment, and graduate school opportunities is sent directly to the BME faculty or the department. When this happens, the information will be distributed to BME students via emails or posted on the bulletin board outside the BME departmental office.

Have a Question?

There are various resources available to assist you including, but not limited to, this Handbook. Some of these additional resources are people and they are presented below as well as FAQs and information for students considering a transfer either to Pratt or to Trinity.

Who Can Help?

If you are unable to locate the factual answer to your question in this Handbook or you are seeking personalized guidance or advice, the following resources are available to you. Note, you can identify your Faculty Advisor and Academic Dean on [DukeHub](#). Each is listed under their respective tabs in the “Student Advisors” panel, which you can find by scrolling down your home page (at the lower right).

Faculty Advisor

Your assigned faculty advisor is your primary contact in regards to exploring the profession, advising on the overarching aspects of your academic plans, registering for courses, and strategizing over near-term career objectives. Though your advisor possesses a wealth of knowledge and experience and they have a lot to offer you, they likely will not possess the answers to all your questions. For example, they likely won't know what the work load is for a specific SSH course. Utilize your faculty advisor for the types of information they are best suited to provide.

At times, some faculty members' travel schedules or other commitments may leave them unable to give each of their advisees as much time as is needed or desired, or academic issues may arise requiring the expertise of other faculty or administration. Under such circumstances, please contact the DUS.

E-Team (Peer Advisors)

The E-Team is comprised of upper-class engineering students who serve as Pratt's peer advisory group. They love to answer questions on classes, student groups, and life on campus, among others. You may reach members of the E-Team through the [E-Team website](#).⁵

BME Director of Undergraduate Studies (DUS)

Marc Sommer (photo on p. 3)
254 Hudson Hall Annex
marc.sommer@duke.edu
919-684-7015

The DUS is responsible for monitoring and enforcing all aspects of the BME undergraduate experience, including curricular requirements, advising, scheduling courses, and staffing teaching assistants. The DUS can assist you when: your advisor cannot answer a question; you need course approvals related to study abroad; are taking a course at another university; you have concerns about a course; or you would like a change in advisor. If the DUS is unable to resolve your question or issue, you should contact your Academic Dean.

Academic Dean

You are assigned a Pratt Academic Dean upon matriculating to the university and will keep your Academic Dean throughout your four year tenure at Duke. The three deans are: Dean Lupita McMillian, Dean Carmen Rawls, and Dean Jim Gaston (photos on p. 5). Your academic dean can, for example, assist you in preparing four-year plans, discuss options if you are having a difficulty, approve overloads and underloads, and explain Pratt policies and procedures.

Can I transfer courses to Duke? If so, how do I do this?

Yes. The Pratt policy on transfer credits, and how the process works, is available at the Pratt Policies and Procedures [webpage](#).⁶

⁵ <http://www.pratt.duke.edu/undergrad/students/advising/e-team>

⁶ <http://www.pratt.duke.edu/undergrad/policies/3659>

Considering a Transfer to or from Pratt?

If you are contemplating a transfer, either Trinity to Pratt or Pratt to Trinity, you should schedule a meeting with Dean McMillian. Additional information is available at the [Pratt Policies and Procedures](#).⁷

Could You Benefit from Some Support?

Academic Resource Center (ARC)

The [Academic Resource Center](#)⁸ (ARC) offers a variety of programs and services to support the academic work of all Duke undergraduates. Services are provided through the Academic Skills Instructional Program (ASIP), the Peer Tutoring Program (PTP), and the Program for Students with Disabilities (PSD). Students may receive individualized support through any of the three ARC programs. Opportunities for students to learn in groups are also offered each semester. On their website, “self-serve” learning resources are available where students can assess their academic skills and learning styles using inventories and self-assessment surveys. Online learning strategy handouts are provided to guide students' learning in courses. The professional staff members of the ARC collaborate to ensure that each student who visits or is referred to the Center receives information and services based on individual academic support needs.

Academic Accommodations

Duke University is prepared to make reasonable academic adjustments and accommodations to allow students with documented disabilities full participation in the same programs and activities available to students without disabilities. Additional information is available at the [Student Disability Access Office](#).

Counseling and Psychological Services (CAPS)

[Counseling and Psychological Services](#)⁹ (CAPS) helps Duke students enhance strengths and develop abilities to successfully live, grow and learn in their personal and academic lives. They offer many services to Duke undergraduate, graduate, and professional students, including brief individual counseling/psychotherapy, consultation, couples and group counseling, assistance with referrals, and more. CAPS staff also provide outreach education programs to student groups, particularly programs supportive of at-risk populations, on a wide range of issues impacting them in various aspects of campus life.

The CAPS staff includes psychologists, clinical social workers, and psychiatrists experienced in working with college-age adults. From the everyday challenges of life to more profound impairment or "interruption" of daily functioning, they recognize that any student may face some level of challenge at any point in their careers here at Duke. Their work is guided by sensitivity to the needs of a diverse student body.

Personal Emergencies and Additional Services

Information regarding [personal emergencies](#)¹⁰ as well as [additional services](#)¹¹ are available on Pratt's Policy and Procedures webpage.

⁷ <http://www.pratt.duke.edu/undergrad/policies/3537>

⁸ <http://duke.edu/arc/>

⁹ <http://studentaffairs.duke.edu/caps>

¹⁰ <http://pratt.duke.edu/undergrad/students/policies/60858>

¹¹ <http://www.pratt.duke.edu/undergrad/policies/3530>

APPENDICES

Tables 1-4: Sample Curriculum Schedules for BME Majors and Dual Majors

Please be careful to check the Sample Schedule for *your* matriculating class!

The matriculating classes of 2014 and earlier include current seniors and juniors.

The matriculating classes of 2015 and later include current sophomores and freshmen.

Table 1a: BME Major (matriculating classes of 2014 and earlier)

Freshman Year	
Fall Semester	Spring Semester
Chem 101DL Core Concepts in Chemistry or Chem 110DL or Chem 21	Bio 201L Gateway to Biol: Molecular Biology
EGR 103L Computational Methods in Engineering	Math 112L Laboratory Calculus II or Math 122L or Math 22
Math 111L Laboratory Calculus I or Math 21	Physics 151L Intro Mechanics or Phy 25
Academic Writing 101	Social Science or Humanities Elective
Sophomore Year	
Fall Semester	Spring Semester
BME 244L Quant Physiology with Biostat Appl	EGR 201L Mechanics of Solids
ECE 110L Fund Electr and Comput Eng	Chem 210DL Mod Apps Chem Principles or Chem 201DL Organic Chem
Math 212 Multivariable Calculus ¹	Math 216 Linear Algebra and Differential Eqn ¹
Physics 152L Intro Electr Magn Opt or Phy 26 ²	Life Science Elective
Social Science or Humanities Elective	Social Science or Humanities Elective
Junior Year	
Fall Semester	Spring Semester
BME 260L Modeling Cellul and Molecul Systems	BME 354L Intro to Medical Instrumentation
BME 271 Signals & Systems or ECE 280L	BME Area Core Class I ³
ME 221L Structure and Properties of Solids	BME Area Core Class II ³
Math 353 Ordinary and Partial Diff Equations ¹	Social Science or Humanities Elective
Senior Year	
Fall Semester	Spring Semester
BME Design ⁴	BME Area Elective ⁵
BME Area Elective ⁵	BME General Elective ⁶
BME General Elective ⁶	Social Science or Humanities Elective
Elective	Elective

1. Students with BME/Math Second-major need to take Math 221+(212 or 222)+356 in place of Math 212+216+353.
2. See also the Physics requirements on pp. 8-9.
3. Selected from the four Area Core classes listed in Table 5.
4. Selected from the following list:
 - BME 432L Biomechanics of Vehicle Safety Engineering
 - BME 436L Biophotonics Instrumentation
 - BME 460L Devices for People with Disabilities
 - BME 462L Design for the Developing World
 - BME 464L Medical Instrument Design
 - BME 490L Special Topics in BME Design
5. Both BME Area Electives (Tables 5-6) must be from the same Area of Focus.
6. BME General Electives can be at any level.

Table 1b: BME Major planning for medical school (matriculating classes of 2014 and earlier)

Freshman Year	
Fall Semester	Spring Semester
Chem 101DL Core Concepts in Chemistry or Chem 110D or Chem 21 (AP)	Social Science or Humanities Elective ⁴
EGR 103L Computational Methods in Engineering	Biol 201L Gateway to Biol: Molecular Biology <i>[alt: Social Science or Humanities Elective]</i>
Math 111L Laboratory Calculus I or Math 21 (AP)	Math 112L Laboratory Calculus II or Math 22 (AP)
Academic Writing 101	Physics 151L Intro Mechanics or Phy 25 (AP)
Sophomore Year	
Fall Semester	Spring Semester
BME 244L Quant Physiology with Biostat Appl <i>[alt: Bio 201L]</i>	ECE 110L Fund Electr and Comput Eng
EGR 201L Mechanics of Solids	Chem 210DL Modern Appl Chem Principles Math 216 Linear Algebra and Differential Eqn ¹
Math 212 Multivariable Calculus ¹	ME 221L Structure and Properties of Solids
Physics 152L Intro Electr Magn Opt or Phy 26 (AP) ²	
<i>Unless a student has AP credits, Organic Chemistry should be taken in the summer after freshman or sophomore year</i>	
Chem 201DL Organic Chemistry	Chem 202DL Organic Chemistry
Junior Year	
Fall Semester	Spring Semester
BME 260L Modeling Cellul and Molecul Systems	BME 354L Intro to Medical Instrumentation
BME 271 Signals & Systems or ECE 280L	BME Area Core Class I ³
Biochem 301 Biochemistry	BME Area Core Class II ³
Math 353 Ordinary and Partial Differential Eqn ¹	Social Science or Humanities Elective ⁴
Senior Year	
Fall Semester	Spring Semester
BME Design ⁵	BME Area Elective ⁶
BME Area Elective ⁶	BME General Elective ⁷
BME General Elective ⁷	Social Science or Humanities Elective
Social Science or Humanities Elective	Social Science or Humanities Elective

1. Students with BME/Math Second-major need to take Math 221+(212 or 222)+356 in place of Math 212+216+353.
2. See also the Physics requirements on pp. 8-9.
3. Selected from the four Area Core classes listed in Table 5.
4. Recommended: Psychology 101 and Sociology 110 or similar courses. See footnote 5 on page 15.
5. Selected from the following list:
 - BME 432L Biomechanics of Vehicle Safety Engineering
 - BME 436L Biophotonics Instrumentation
 - BME 460L Devices for People with Disabilities
 - BME 462L Design for the Developing World
 - BME 464L Medical Instrument Design
 - BME 490L Special Topics in BME Design
6. Both BME Area Electives (Tables 5-6) must be from the same Area of Focus.
7. BME General Electives can be at any level.

Please note: Students considering medical school should speak directly to their prehealth advisor for the most current information and visit the prehealth website for details: <http://prehealth.duke.edu/prepare>. Students may find that placing one or two semesters of organic chemistry into the summer, either at Duke or at home, can help with scheduling. While medical schools usually prefer to see organic chemistry taken at Duke, Pratt students can be an exception.

Table 1c: BME Major (matriculating classes of 2015 and later)

Freshman Year	
Fall Semester	Spring Semester
Chem 101DL Core Concepts in Chemistry or Chem 110DL or Chem 21	Bio 201L Gateway to Biol: Molecular Biology
EGR 103L Computational Methods in Engineering	Math 112L Laboratory Calculus II or Math 122L or Math 22
Math 111L Laboratory Calculus I or Math 21	Physics 151L Intro Mechanics or Phy 25
Academic Writing 101	Social Science or Humanities Elective
Sophomore Year	
Fall Semester	Spring Semester
BME 244L Quant Physiology with Biostat Appl	EGR 201L Mechanics of Solids
ECE 110L Fund Electr and Comput Eng	Chem 210DL Mod Apps Chem Principles or Chem 201DL Organic Chem
Math 212 Multivariable Calculus ¹	Math 216 Linear Algebra and Differential Eqn ¹
Physics 152L Intro Electr Magn Opt or Phy 26 ²	Life Science Elective
Social Science or Humanities Elective	Social Science or Humanities Elective
Junior Year	
Fall Semester	Spring Semester
BME 260L Modeling Cellul and Molecul Systems	BME 354L Intro to Medical Instrumentation
BME 271 Signals & Systems or ECE 280L	BME Area Core Class I ³
ME 221L Structure and Properties of Solids	BME Area Core Class II ³
Math 353 Ordinary and Partial Diff Equations ¹	Social Science or Humanities Elective
Senior Year	
Fall Semester	Spring Semester
BME Design ⁴	BME Advanced Elective ⁵
BME Advanced Elective ⁵	BME General Elective ⁶
BME Advanced Elective ⁵	Social Science or Humanities Elective
Elective	Elective

1. Students with BME/Math Second-major need to take Math 221+(212 or 222)+356 in place of Math 212+216+353.

2. See also the Physics requirements on pp. 8-9.

3. Selected from the four Area Core classes listed in Table 5.

4. Selected from the following list:

BME 432L Biomechanics of Vehicle Safety Engineering

BME 436L Biophotonics Instrumentation

BME 460L Devices for People with Disabilities

BME 462L Design for the Developing World

BME 464L Medical Instrument Design

BME 490L Special Topics in BME Design

5. Two of the Advanced Electives must have the same Area of Focus (Tables 5-6).

6. The BME General Elective can be at any level. A fourth Advanced Elective can be taken instead.

Table 1d: BME Major planning for medical school (matriculating classes of 2015 and later)

Freshman Year	
Fall Semester	Spring Semester
Chem 101DL Core Concepts in Chemistry or Chem 110D or Chem 21 (AP)	Social Science or Humanities Elective ⁴
EGR 103L Computational Methods in Engineering	Biol 201L Gateway to Biol: Molecular Biology <i>[alt: Social Science or Humanities Elective]</i>
Math 111L Laboratory Calculus I or Math 21 (AP)	Math 112L Laboratory Calculus II or Math 22 (AP)
Academic Writing 101	Physics 151L Intro Mechanics or Phy 25 (AP)
Sophomore Year	
Fall Semester	Spring Semester
BME 244L Quant Physiology with Biostat Appl <i>[alt: Bio 201L]</i>	ECE 110L Fund Electr and Comput Eng
EGR 201L Mechanics of Solids	Chem 210DL Modern Appl Chem Principles Math 216 Linear Algebra and Differential Eqn ¹
Math 212 Multivariable Calculus ¹	ME 221L Structure and Properties of Solids
Physics 152L Intro Electr Magn Opt or Phy 26 (AP) ²	
<i>Unless a student has AP credits, Organic Chemistry should be taken in the summer after freshman or sophomore year</i>	
Chem 201DL Organic Chemistry	Chem 202DL Organic Chemistry
Junior Year	
Fall Semester	Spring Semester
BME 260L Modeling Cellul and Molecul Systems	BME 354L Intro to Medical Instrumentation
BME 271 Signals & Systems or ECE 280L	BME Area Core Class I ³
Biochem 301 Biochemistry	BME Area Core Class II ³
Math 353 Ordinary and Partial Differential Eqn ¹	Social Science or Humanities Elective ⁴
Senior Year	
Fall Semester	Spring Semester
BME Design ⁵	BME Advanced Elective ⁶
BME Advanced Elective ⁶	BME General Elective ⁷
BME Advanced Elective ⁶	Social Science or Humanities Elective
Social Science or Humanities Elective	Social Science or Humanities Elective

1. Students with BME/Math Second-major need to take Math 221+(212 or 222)+356 in place of Math 212+216+353.
2. See also the Physics requirements on pp. 8-9.
3. Selected from the four Area Core classes listed in Table 5.
4. Recommended: Psychology 101 and Sociology 110 or similar courses. See footnote 5 on page 15.
5. Selected from the following list:
 - BME 432L Biomechanics of Vehicle Safety Engineering
 - BME 436L Biophotonics Instrumentation
 - BME 460L Devices for People with Disabilities
 - BME 462L Design for the Developing World
 - BME 464L Medical Instrument Design
 - BME 490L Special Topics in BME Design
6. Two of the Advanced Electives must have the same Area of Focus (Tables 5-6).
7. The BME General Elective can be at any level. A fourth Advanced Elective can be taken instead.

Please note: Students considering medical school should speak directly to their prehealth advisor for the most current information and visit the prehealth website for details: <http://prehealth.duke.edu/prepare>. Students may find that placing one or two semesters of organic chemistry into the summer, either at Duke or at home, can help with scheduling. While medical schools usually prefer to see organic chemistry taken at Duke, Pratt students can be an exception.

Table 2a: BME/ECE Second Major (matriculating classes of 2014 and earlier)

Freshman Year	
Fall Semester	Spring Semester
Chem 101DL Core Concepts in Chemistry or Chem 110DL or Chem 21	Biol 201L Gateway to Biol: Molecular Biology
EGR 103L Computational Methods in Engineering	Math 112L Laboratory Calculus II or Math 122L or Math 22
Math 111L Laboratory Calculus I or Math 21	Physics 151L Intro Mechanics or Phy 25
Acad Writing 101 /Social Sci or Humanities Elect 1	Social Sci or Humanities Elect 1 /Acad Writing 101
Sophomore Year	
Fall Semester	Spring Semester
BME 244L Quant Physiology with Biostat Appl	Chem 210DL Mod Apps Chem Principles or Chem 201DL Organic Chemistry
EGR 201L Mechanics of Solids	Math 216 Linear Algebra and Differential Eqn
Math 212 Multivariable Calculus	ECE 230L Intro Microelectr Devices & Circuits
Physics 152L Intro Electr Magn Opt or Phy 26 ¹	ECE 280L Intro to Signals & Systems
ECE 110L Fund Electr and Comput Egr	CompSci 201 Data Structures and Algorithms
Junior Year	
Fall Semester	Spring Semester
BME 260L Modeling Cellul and Molecul Systems	BME 354L Intro to Medical Instrumentation
ME 221L Structure and Properties of Solids	BME 301L Bioelectricity or BME 303 Modern Diagnostic Imaging Systems
Math 353 Ordinary and Partial Diff. Equations	ECE Concentration Elective 1 ²
ECE 250L Computer Architecture	Statistics course ³
ECE 270L Intro to Electromagnetic Fields	Social Science or Humanities Elective 2
Senior Year	
Fall Semester	Spring Semester
BME design: BME 436L or BME 464L	BME General Elective ⁵
BME Area Elective ⁴	ECE Elective
ECE Concentration Elective 2 ²	Social Science or Humanities Elective 4
Life Science Elective	Social Science or Humanities Elective 5
Social Science or Humanities Elective 3	

1. See also the Physics requirements on pp. 8-9.
2. At least two ECE Concentration Electives must be from the same Concentration Area
3. Statistics course should be chosen from the ECE options: Stat 130, Math 230, ECE 380, ECE 555
4. If BME 301L is taken, the Area Elective must be in Electrobiolgy (EL).
If BME 303 is taken, the Area Elective must be in Imaging and Measurements (EM).
5. The BME General Elective can be at any level.

Table 2b: BME/ECE Second Major (matriculating classes of 2015 and later)

Freshman Year	
Fall Semester	Spring Semester
Chem 101DL Core Concepts in Chemistry or Chem 110DL or Chem 21	Biol 201L Gateway to Biol: Molecular Biology
EGR 103L Computational Methods in Engineering	Math 112L Laboratory Calculus II or Math 122L or Math 22
Math 111L Laboratory Calculus I or Math 21	Physics 151L Intro Mechanics or Phy 25
Acad Writing 101 /Social Sci or Humanities Elect 1	Social Sci or Humanities Elect 1 /Acad Writing 101
Sophomore Year	
Fall Semester	Spring Semester
BME 244L Quant Physiology with Biostat Appl	Chem 210DL Mod Apps Chem Principles or Chem 201DL Organic Chemistry
EGR 201L Mechanics of Solids	Math 216 Linear Algebra and Differential Eqn
Math 212 Multivariable Calculus	ECE 230L Intro Microelectr Devices & Circuits
Physics 152L Intro Electr Magn Opt or Phy 26 ¹	ECE 280L Intro to Signals & Systems
ECE 110L Fund Electr and Comput Egr	CompSci 201 Data Structures and Algorithms
Junior Year	
Fall Semester	Spring Semester
BME 260L Modeling Cellul and Molecul Systems	BME 354L Intro to Medical Instrumentation
ME 221L Structure and Properties of Solids	BME 301L Bioelectricity or BME 303 Modern Diagnostic Imaging Systems
Math 353 Ordinary and Partial Diff. Equations	ECE Concentration Elective 1 ²
ECE 250L Computer Architecture	Statistics course ³
ECE 270L Intro to Electromagnetic Fields	Social Science or Humanities Elective 2
Senior Year	
Fall Semester	Spring Semester
BME design: BME 436L or BME 464L	BME General Elective ⁵
BME Advanced Elective ⁴	ECE Elective
ECE Concentration Elective 2 ²	Social Science or Humanities Elective 4
Life Science Elective	Social Science or Humanities Elective 5
Social Science or Humanities Elective 3	

1. See also the Physics requirements on pp. 8-9.
2. At least two ECE Concentration Electives must be from the same Concentration Area
3. Statistics course should be chosen from the ECE options: Stat 130, Math 230, ECE 380, ECE 555
4. If BME 301L is taken, the Advanced Elective must be in the Electrobiolgy (EL) Area of Focus.
If BME 303 is taken, the Advanced Elective must be in the Imaging and Measurements (EM) Area of Focus.
5. The BME General Elective can be at any level. An Advanced Elective may be taken instead.

Table 3a: BME/ME Second Major (matriculating classes of 2014 and earlier)

Fall Semester	Spring Semester
Chem 101DL Core Concepts in Chemistry or Chem 110DL or Chem 21	Biol 201L Gateway to Biol: Molecular Biology
EGR 103L Computational Methods in Engineering	Math 112L Laboratory Calculus II or Math 122L or Math 22
Math 111L Laboratory Calculus I or Math 21	Physics 151L Intro Mechanics or Phy 25
Academic Writing 101	EGR 121L Engineering Innovation
	Social Science or Humanities Elective
Sophomore Year	
Fall Semester	Spring Semester
BME 244L Quant Physiology with Biostat Appl	ECE 110L Fund Electr and Comput Eng
EGR 201L Mechanics of Solids	ME 221L Structure and Properties of Solids
Chem 210DL Mod Apps Chem Principles or 201DL Organic Chemistry	Math 216 Linear Algebra and Differential Equations
Math 212 Multivariable Calculus	EGR 244L Dynamics
Physics 152L Intro Electr Magn Opt or Phy 26 ¹	Social Sci or Humanities Elect
Junior Year	
Fall Semester	Spring Semester
BME 260L Modeling Cellul and Molecul Systems	BME 354L Intro to Medical Instrumentation
BME 271 Signals & Systems or ECE 280L	BME 302L Fund Biomechanics/Biomaterials
Math 353 Ordinary and Partial Diff Equations	ME 336L Fluid Mechanics
ME 331L Thermodynamics	Life Science Elective
ME 321L ME Analysis for Design	
Senior Year	
Fall Semester	Spring Semester
ME 344L Control of Dynamic Systems	ME 424L Mechanical Design ²
ME 421L Mechanical Design	BME Biomech/Biomat Area Elective ³
ME 431L Heat and Mass Transfer	ME Elective 2
ME Elective 1	Social Science or Humanities Elective
Social Science or Humanities Elective	Social Science or Humanities Elective

Students with AP credits should pay particular attention to prerequisites when rearranging the schedule.

1. See also the Physics requirements on pp. 8-9.
2. ME 424L with BME project.
3. Selected from Tables 5-6.

Table 3b: BME/ME Second Major (matriculating classes of 2015 and later)

Fall Semester	Spring Semester
Chem 101DL Core Concepts in Chemistry or Chem 110DL or Chem 21	Biol 201L Gateway to Biol: Molecular Biology
EGR 103L Computational Methods in Engineering	Math 112L Laboratory Calculus II or Math 122L or Math 22
Math 111L Laboratory Calculus I or Math 21	Physics 151L Intro Mechanics or Phy 25
Academic Writing 101	EGR 121L Engineering Innovation
	Social Science or Humanities Elective
Sophomore Year	
Fall Semester	Spring Semester
BME 244L Quant Physiology with Biostat Appl	ECE 110L Fund Electr and Comput Eng
EGR 201L Mechanics of Solids	ME 221L Structure and Properties of Solids
Chem 210DL Mod Apps Chem Principles or 201DL Organic Chemistry	Math 216 Linear Algebra and Differential Equations
Math 212 Multivariable Calculus	EGR 244L Dynamics
Physics 152L Intro Electr Magn Opt or Phy 26 ¹	Social Sci or Humanities Elect
Junior Year	
Fall Semester	Spring Semester
BME 260L Modeling Cellul and Molecul Systems	BME 354L Intro to Medical Instrumentation
BME 271 Signals & Systems or ECE 280L	BME 302L Fund Biomechanics/Biomaterials
Math 353 Ordinary and Partial Diff Equations	ME 336L Fluid Mechanics
ME 331L Thermodynamics	Life Science Elective
ME 321L ME Analysis for Design	
Senior Year	
Fall Semester	Spring Semester
ME 344L Control of Dynamic Systems	ME 424L Mechanical Design ²
ME 421L Mechanical Design	BME Advanced Elective in BB Area of Focus ³
ME 431L Heat and Mass Transfer	ME Elective 2
ME Elective 1	Social Science or Humanities Elective
Social Science or Humanities Elective	Social Science or Humanities Elective

Students with AP credits should pay particular attention to prerequisites when rearranging the schedule.

1. See also the Physics requirements on pp. 8-9.
2. ME 424L with BME project.
3. Selected from Tables 5-6.

Table 4a: BME/CEE Second Major (matriculating classes of 2014 and earlier)

Freshman Year	
Fall Semester	Spring Semester
Chem 101DL Core Concepts of Chemistry or Chem 110DL or Chem 21	Bio 201L Gateway to Biol: Molecular Biology
EGR 103L Computational Methods in Engineering	Math 112L Laboratory Calculus II or Math 122L or Math 22
Math 111L Laboratory Calculus I or Math 21	Physics 151L Intro Mechanics or Phy 25
Academic Writing 101	Social Science or Humanities Elective
Sophomore Year	
Fall Semester	Spring Semester
BME 244L Quant Physiology with Biostat Appl	ECE 110L Fund Electr and Comput Eng
EGR 201L Mechanics of Solids	ME 221L Structure and Properties of Solids
Chem 210DL Mod Apps Chem Principle or Chem 201DL Organic Chemistry	Math 216 Linear Algebra and Differential Equations
Math 212 Multivariable Calculus	EGR 244L Dynamics
Physics 152L Intro Electr Magn Opt or Phy 26 ¹	Social Science or Humanities Elective
Junior Year	
Fall Semester	Spring Semester
BME 260L Modeling Cellul and Molecul Systems	BME 354L Intro to Medical Instrumentation
BME 271 Signals and Systems or ECE 280L	BME 302L Fund Biomechanics/Biomaterials or BME 307 Transport Phenom in Biological Systems
Math 353 Ordinary and Partial Diff Equations	CEE 462L Bio Principles in Environmental Egr
CEE 461L Chem Principles in Env Egr	CEE 201L Uncertainty Design and Optimization
CEE 301L Fluid Mechanics	Stat 130 Probability and Statistics in Engineering
Senior Year	
Fall Semester	Spring Semester
CEE 463L Water Resources Engineering	BME/CEE Design ³
EGR 305 Egr System Optim Econ	BME Area Elective ⁴
CEE Elective ²	Social Science or Humanities Elective
Life Science Elective	Social Science or Humanities Elective
Social Science or Humanities Elective	

1. See also the Physics requirements on pp. 8-9.

2. Selected from the following list of CEE electives:

CEE 561 Environmental Aquatic Chemistry	CEE 581 Pollutant Transport Systems
CEE 562 Biological Processes in Environ Engineering	CEE 661L Environmental Molecular Biotech
CEE 563 Chemical Fate of Organic Compounds	CEE 671 Physicochemical Unit Operations in Water Treatment
CEE 564 Physical Chemical Processes in Environ Egr	CEE 672 Solid Waste Engineering
CEE 571 Control of Hazardous and Toxic Waste	CEE 685 Water Supply Engineering Design
CEE 575 Air Pollution Control Engineering	

3. Selected from the following list:

CEE 469 Integrated Environmental Design
BME 462L Design for the Developing World

4. If BME 302L is taken, the Area Elective must come from the Biomaterials/Biomechanics (BB) Area

If BME 307 is taken, the Area Elective must come from the Molecular, Cellular and Tissue Engineering (MC) Area

Table 4b: BME/CEE Second Major (matriculating classes of 2015 and later)

Freshman Year	
Fall Semester	Spring Semester
Chem 101DL Core Concepts of Chemistry or Chem 110DL or Chem 21	Bio 201L Gateway to Biol: Molecular Biology
EGR 103L Computational Methods in Engineering	Math 112L Laboratory Calculus II or Math 122L or Math 22
Math 111L Laboratory Calculus I or Math 21	Physics 151L Intro Mechanics or Phy 25
Academic Writing 101	Social Science or Humanities Elective
Sophomore Year	
Fall Semester	Spring Semester
BME 244L Quant Physiology with Biostat Appl	ECE 110L Fund Electr and Comput Eng
EGR 201L Mechanics of Solids	ME 221L Structure and Properties of Solids
Chem 210DL Mod Apps Chem Principle or Chem 201DL Organic Chemistry	Math 216 Linear Algebra and Differential Equations
Math 212 Multivariable Calculus	EGR 244L Dynamics
Physics 152L Intro Electr Magn Opt or Phy 26 ¹	Social Science or Humanities Elective
Junior Year	
Fall Semester	Spring Semester
BME 260L Modeling Cellul and Molecul Systems	BME 354L Intro to Medical Instrumentation
BME 271 Signals and Systems or ECE 280L	BME 302L Fund Biomechanics/Biomaterials or BME 307 Transport Phenom in Biological Systems
Math 353 Ordinary and Partial Diff Equations	CEE 462L Bio Principles in Environmental Egr
CEE 461L Chem Principles in Env Egr	CEE 201L Uncertainty Design and Optimization
CEE 301L Fluid Mechanics	Stat 130 Probability and Statistics in Engineering
Senior Year	
Fall Semester	Spring Semester
CEE 463L Water Resources Engineering	BME/CEE Design ³
EGR 305 Egr System Optim Econ	BME Advanced Elective ⁴
CEE Elective ²	Social Science or Humanities Elective
Life Science Elective	Social Science or Humanities Elective
Social Science or Humanities Elective	

1. See also the Physics requirements on pp. 8-9.

2. Selected from the following list of CEE electives:

CEE 561 Environmental Aquatic Chemistry
 CEE 562 Biological Processes in Environ Engineering
 CEE 563 Chemical Fate of Organic Compounds
 CEE 564 Physical Chemical Processes in Environ Egr
 CEE 571 Control of Hazardous and Toxic Waste
 CEE 575 Air Pollution Control Engineering

CEE 581 Pollutant Transport Systems
 CEE 661L Environmental Molecular Biotech
 CEE 671 Physicochemical Unit Operations in Water Treatment
 CEE 672 Solid Waste Engineering
 CEE 685 Water Supply Engineering Design

3. Selected from the following list:

CEE 469 Integrated Environmental Design
 BME 462L Design for the Developing World

4. If BME 302L is taken, the Advanced Elective must be in the Biomaterials/Biomechanics (BB) Area of Focus.

If BME 307 is taken, the Advanced Elective must be in the Molecular, Cellular and Tissue Engineering (MC) Area of Focus.

Table 5: BME Area Electives

(For matriculating classes of 2015 and later, these are Advanced Electives with an Area of Focus)

(See also Table 6)

(BB)	Biomechanics and Biomaterials <i>Core Class: BME 302L Fund of Biomaterials and Biomechanics</i>	(EL)	Electrobiology <i>Core Class: BME 301L Bioelectricity</i>
BME 507	Cardiovasc System Egr, Disease, Therapy*	BME 502	Neural Signal Acquisition
BME 522L	Intro to Bionanotechnology Engineering	BME 503	Computational Neuroengineering
BME 523	Biomedical Polymers	BME 504	Fundamentals of Electrical Stimulation of the Nervous System
BME 524	Nanotechnology in Medicine	BME 506	Measurem. & Control of Cardiac Electr. Events
BME 525	Biomedical Materials and Artificial Organs	BME 507	Cardiovasc System Egr, Disease, Therapy*
BME 526	Elasticity	BME 510	Bayesian Analysis on Biomed Engineering
BME 527	Cell Mechanics and Mechanotransduction	BME 511L	Intermediate Bioelectricity
BME 528	Biofluid Mechanics	BME 512L	Cardiac Bioelectricity
BME 529	Theoretical and Applied Polymer Science	BME 513	Nonlinear Dynamics in Electrophysiology
BME 530	Intro Tissue Biomechanics	BME 515	Neural Prosthetic Systems
BME 531	Intermediate Biomechanics	BME 517	Neuronal Control of Movement
BME 535	Biomed Aspects of Blasts and Ballistics	BME 545	Acoustics and Hearing
BME 563	Transport Proc in HIV Transm & Prevention*	BME 560	Molecular Basis of Membrane Transport
BME 570L	Introduction to Biomolecular Engineering		
BME 571L	Biotechnology and Bioprocess Engineering		
BME 577	Drug Transport Analysis*		
BME 578	Quantitative Cell and Tissue Engineering		
(IM)	Imaging and Measurement Systems <i>Core Class: BME 303, Modern Diagnostic Imaging Systems</i>	(MC)	Molecular, Cellular and Tissue Eng <i>Core Class: BME 307, Transport Phenomena in Biological Systems</i>
BME 502	Neural Signal Acquisition	BME 522L	Intro to Bionanotechnology Engineering*
BME 506	Measurem and Control Cardiac Electr Events*	BME 523	Biomedical Polymers*
BME 515	Neural Prosthetic Systems*	BME 524	Nanotechnology in Medicine
BME 542	Principles of Ultrasound Imaging	BME 527	Cell Mechanics and Mechanotransduction
BME 543L	Cardiac Ultrasound Imaging and Function	BME 528	Biofluid Mechanics
BME 544	Digital Image Processing	BME 560	Molecular Basis of Membrane Transport
BME 545	Acoustics and Hearing	BME 561L	Genome Science & Technology Lab
BME 550	Modern Microscopy	BME 562	Biology by Design
BME 551	Biomed Opt Spectroscopy and Tissue Optics	BME 563	Transport Proc in HIV Transm & Prevention
BME 552	Advanced Optics	BME 565L	Environmental Molecular Biotechnology
BME 555	Advances in Photonics	BME 566	Transport Phenomena in Cells and Organs
BME 567	Biosensors	BME 567	Biosensors
		BME 568	Lab in Cellular and Biosurface Eng
		BME 569	Cell Transport Mechanisms
		BME 570L	Intro. to Biomolecular Engineering
		BME 571L	Biotechnology and Bioprocess Engineering
		BME 574	Modeling and Engineering Gene Circuits
		BME 577	Drug Transport Analysis
		BME 578	Quantitative Cell and Tissue Engineering

*This course has a prerequisite that is *beyond* BME required courses or this area's Core Class.

Table 6: Area Designations of BME Special Topics Courses
(taught within last four years)

Course Section	Areas*
BME 290 Med Instrument Developing World	GE
BME 290 Women's Health Technology	GE
BME 490L Biomedical and Clinical Design†	
BME 490L Biochemical Engineering Design†	
BME 590 Advanced Biomaterials	BB, GE
BME 590 Bayesian Quant Electrophysiology	EL, GE
BME 590 Biomedical Instrument System Design	IM, GE
BME 590L Biomedical Optics	IM, GE
BME 590 Biomedical Polymers	BB, MC, GE
BME 590L Biopotential Amplifiers and Implant Devices	EL, IM, GE
BME 590 Biophysical Neuroscience Tools	EL, IM, GE
BME 590 Computational Foundation of Biomedical Simulation	BB, GE
BME 590 Computational Transport Analysis	BB, MC, GE
BME 590 Computational Methods in Neuroscience	EL, GE
BME 590 Engineered Self-Assembly	BB, MC, GE
BME 590 Intercontinental Engineering Design	GE
BME 590L Introduction to Finite Element Analysis	GE
BME 590 Image Processing	IM, GE
BME 590 Intelligent Sensors in Medical Instrumentation	IM, GE
BME 590 Introduction to Tissue Engineering	MC, GE
BME 590 Medical Device Software Design	IM, GE
BME 590 Metabolic Networks and Design	MC, GE
BME 590L Mobile Devices for Biomedicine	IM, GE
BME 590 Modern Ultrasound Lab Methods	IM, GE
BME 590 MRI: Principles and Sequence Design	IM, GE
BME 590 Practical Medical Devices	IM, GE
BME 590 Programmed Assembly of Soft Matter	BB, MC, GE
BME 590 Statistics in BME	GE
BME 590 Synth Biology Metabolic Egr	MC, GE
BME 590 Synthetic Genomics	MC, GE
BME 590 Topics in Nanomedicine	BB, MC, GE
BME 590 Ultrasound System Design	IM, GE
BME 590 Vehicle Safety Engineering†	BB, GE

*Elective designations: BB: Biomechanics and Biomaterials; EL: Electrobiolgy; IM: Imaging and Measurement Systems; MC: Molecular, Cellular, and Tissue Engineering; GE: General Elective.

† Satisfies design requirement.

Table 7: Approved BME Life Science Elective Courses

Biochemistry

Biochem 301 Introductory Biochemistry I: Intermediary Metabolism
Biochem 302 Introductory Biochemistry II

Biology

Biology 202L Gateway to Biology: Genetics and Evolution
Biology 212L General Microbiology
Biology 213 Cell Signaling and Diseases
Biology 214L Experimental Cell and Molecular Biology
Biology 215 Introduction to Mathematical Modeling in Biology
Biology 220 Cellular and Developmental Biology
Biology 223 Cellular and Molecular Neurobiology (C-L: Neurosci 223)
Biology 224 Fundamentals of Neuroscience (C-L: Neurosci 201)
Biology 250 Population Genetics
Biology 251L Molecular Evolution
Biology 278LA Comparative Physiology of Marine Animals
Biology 311 Systems Biology: An Introduction for the Quantitative Sciences
Biology 322 From Neurons to Brain (C-L: Neurosci 322)
Biology 330L Comparative and Functional Anatomy of the Vertebrates
Biology 350 Complex Traits and Evolutionary Genetics
Biology 365 From Influenza A to Varicella Zoster: The Physiology, Ecology, and
 Evolution of Infectious Disease
Biology 372LA Biochemistry of Marine Animals
Biology 377LA Marine Invertebrate Zoology
Biology 418 Introduction to Biophysics (C-L: Physics 414)
Biology 515 Principles of Immunology
Biology 650 Molecular Population Genetics
Biology 783 Developmental Genetics

Chemistry

Chem 302 How Does Biology Work? The Physical and Chemical Underpinnings of
 Biological Nanomachines

Computer Sciences

Compsci 260 Introduction to Computational Genomics

Evolutionary Anthropology

Evanth 231L Anatomy of the Lower Extremities
Evanth 235L Primate Anatomy
Evanth 333L The Human Body
Evanth 530 Human Functional Anatomy

Neuroscience

Neurosci 201 Fundamentals of Neuroscience (C-L: Biology 224)
Neurosci 212 Introduction to Cognitive Neuroscience
Neurosci 223 Cellular and Molecular Neurobiology (C-L: Biology 223)
Neurosci 322 From Neurons to Brain (C-L: Biology 322)

Pharmacology

Pharm 350 Pharmacology: Drug Actions and Reactions
Pharm 533 Essentials of Pharmacology and Toxicology

Pharm 554

Mammalian Toxicology

Physics

Physics 414

Introduction to Biophysics (C-L: Biology 418)

Table 8: Approved Social Science and Humanities Departments and Programs

Recently, non-social science and non-humanities departments have received SS, CZ, or ALP codes for some courses. Pratt’s requirement to take five SSH courses is intended to provide breadth and depth in the social sciences and humanities.

Please note that Global Health (GLHLTH) is not an approved department, but that many Global Health classes may be cross-listed with other approved departments or programs. Global Health classes with course codes that are cross-listed with other departments/programs can be used for SSH requirements, but one cannot satisfy the SSH depth requirement with two Global Health courses if they are cross-listed with different departments/programs. Global Health courses without cross-lists can only be used as free electives.

Taking a 200 level or higher course from an unapproved department that is cross-listed with another department cannot be used to satisfy the depth requirement, unless the student has permission from the BME DUS.

Pratt requires that the five SSH courses must be taken from, or cross-listed with, the following departments or programs:

Department/Program	Subject Code(s)
African & African American Studies	AAAS
Art, Art History, and Visual Media Studies	ARTHIST, HCVIS, ARTSVIS, VMS
Arts of the Moving Image	AMI
Asian and Middle Eastern Studies	AMES, ARABIC, CHINESE, HEBREW, HINDI, JPN, KOREAN, PERSIAN, SANSKRIT, TIBETAN
Canadian Studies	CANADIAN
Classical Studies	CLST, GREEK, LATIN
Cultural Anthropology	CULANTH
Documentary Studies	DOCST
East Asian Studies	EAS
Economics	ECON
Education	EDUC
English	ENGLISH
Study of Ethics	ETHICS
Evolutionary Anthropology	EVANTH
Germanic Languages and Literature	GERMAN
History	HISTORY
Innovation & Entrepreneurship	I&E
International Comparative Studies	ICS
Islamic Studies	ISLAMST
Jewish Studies	JEWISHST
Latin American Studies	LATAMER
Linguistics	LINGUIST
Literature Program in Global Cultural Studies	LIT
Markets and Management Studies	MMS
Medieval and Renaissance Studies	MEDREN
Music	MUSIC
Philosophy	PHIL

Political Science	POLSCI
Psychology and Neuroscience	PSY
Public Policy Studies	PUBPOL
Religious Studies	RELIGION
Romance Studies	ROMST, CREOLE, FRENCH, ITALIAN, PORTUGUE, QUECHUA, SPANISH
Slavic and Eurasian Studies	SES, BALTFIN, POLISH, ROMANIAN, RUSSIAN, SERBCRO, TURKISH, UKRAIN, UZBEK
Sociology	SOCIOL
Theater Studies	THEATRST
Women's Studies	WOMENST

Note that individual departments and programs may constitute one or more subject codes.
EXCEPTIONS: EGR 305/ECON 212. Even though EGR 305 is cross-listed with ECON (within the economics department) it cannot be used toward the SSH requirement.

Table 9: BME Required Courses That Are Prerequisites for Other BME Courses

EGR 103L	Computational Methods in Engineering	BME 98, BME 244L, BME 542, BME 577
ECE 110L	Fundamentals of Electrical and Computer Engineering	BME 271, BME 301L, BME 354L, BME 515
EGR 201L	Mechanics of Solids	BME 302L, BME 526, BME 530, BME 531, BME 535, ME 221L
ME 221L	Structure and Properties of Solids	BME 302L, BME 525, BME 571L
BME 244L	Quantitative Physiology with Biostatistical Applications	BME 260L*, BME 301L, BME 302L, BME 303, BME 307, BME 354L
BME 260L	Modeling Cellular and Molecular Systems	BME 307, BME 574, BME 570L
BME 271	Signals and Systems	BME 303, BME 354L, BME 545
BME 354L	Introduction to Medical Instrumentation	BME 436L, BME 460L, BME 462L, BME 464L, BME 502, BME 506, BME 55
BME 301L	Bioelectricity	BME 503, BME 506, BME 507, BME 511L, BME 512L, BME 513, BME 515, BME 517
BME 302L	Fundamentals of Biomaterials and Biomechanics	BME 427L, BME 432L, BME 507, BME 522L, BME 523, BME 524, BME 527, BME 528, BME 530, BME 578
BME 303	Modern Diagnostic Imaging Systems	BME 542, BME 550
BME 307	Transport Phenomena in Biological Systems	BME 427L, BME 507, BME 524, BME 527, BME 528, BME 563, BME 566, BME 568, BME 569, BME 577, BME 578

* May be taken as a co-requisite

Table 10: Complete list of BME and Relevant Courses and Course Titles

Required:

BME 244L Quantitative Physiology with Biostatistical Applications
BME 253L Biomedical Electronic Measurements I
BME 260L Modeling Cellular and Molecular Systems
BME 271 Signals and Systems
BME 354L Introduction to Medical Instrumentation

Area Core:

BME 301L Bioelectricity
BME 302L Fundamentals of Biomaterials and Biomechanics
BME 303 Modern Diagnostic Imaging Systems
BME 307 Transport Phenomena in Biological Systems

Design:

BME 432L Biomechanics and Vehicle Safety Engineering
BME 436L Biophotonic Instrumentation
BME 460L Devices for People with Disabilities
BME 462L Design for the Developing World
BME 464L Medical Instrumentation Design
BME 490L Special Topics in BME Design (Biomed. and Clinical Design)

Area Electives:

BME 502 Neural Signal Acquisition
BME 503 Computational Neuroengineering
BME 504 Fundamentals of Electrical Stimulation of the Nervous System
BME 506 Measurement and Control of Cardiac Electrical Events
BME 510 Bayesian Analysis in Biomedical Engineering
BME 511L Intermediate Bioelectricity
BME 512L Cardiac Bioelectricity
BME 513 Nonlinear Dynamics in Electrophysiology
BME 515 Neural Prosthetic Systems
BME 517 Neuronal Control of Movement
BME 523 Biomedical Polymers
BME 524 Nanotechnology in medicine
BME 525 Biomedical Materials and Artificial Organs
BME 527 Cell Mechanics and Mechanotransduction
BME 528 Biofluid Mechanics
BME 530 Tissue Biomechanics
BME 542 Principles of Ultrasound Imaging
BME 544 Digital Image Processing
BME 550 Modern Microscopy
BME 551L Biomedical Optical Spectroscopy and Tissue Optics
BME 552 Advanced Optics
BME 560 Molecular Basis of Membrane Transport
BME 561L Genome Science and Technology Lab
BME 562 Biology by Design
BME 563 Transport Process in HIV Transmission and Prevention
BME 567 Biosensors
BME 570L Introduction to Biomolecular Engineering
BME 574 Modeling and Engineering Gene Circuits

BME 577 Drug Transport Analysis
BME 578 Quantitative Cell and Tissue Engineering

General Electives:

BME 90L Introduction to Biomedical Engineering
BME 255 Safety of Medical Devices
BME 290 Women's Health Technologies
BME 385 Introduction to Business in Technology-Based Companies

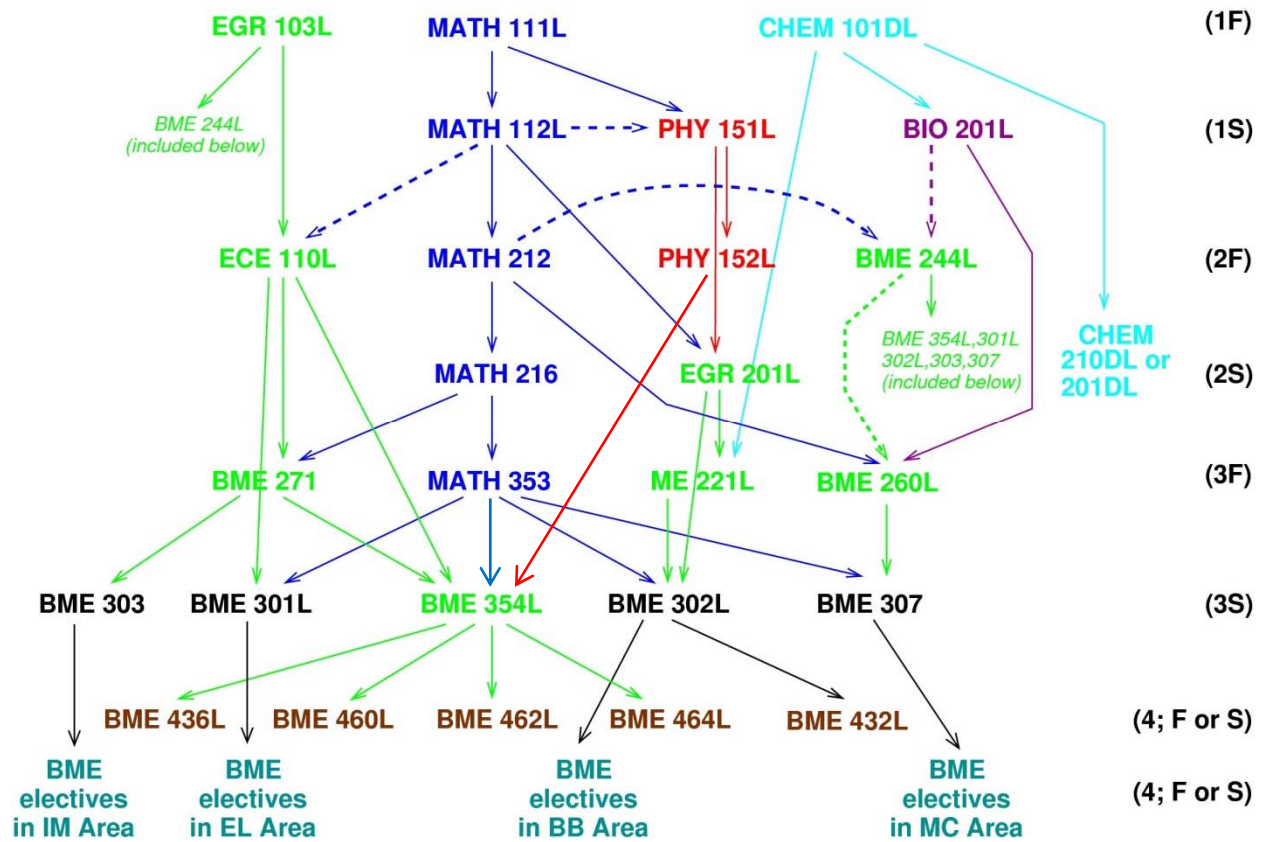
BME 290, 490, and 590 Special Topics Courses:

See Table 6

Courses Taught by Other Departments:

Biology 201L Gateway to Biology: Molecular Biology
Chem 101DL Core Concepts in Chemistry
Chem 110L Core Concepts in Chemistry, Honors Section
Chem 201DL Organic Chemistry 1
Chem 202L Chemistry 2
Chem 210DL Modern Applications of Chemical Principles
ECE 110L Fundamentals of Electrical and Computer Engineering
ECE 280L Introduction to Signals and Systems
EGR 103L Computational Methods in Engineering
EGR 201L Mechanics of Solids
Math 111L Laboratory Calculus I
Math 112L Laboratory Calculus II
Math 212 Multivariable Calculus
Math 216 Linear Algebra and Differential Equations
Math 353 Ordinary and Partial Differential Equations
ME 221L Structure and Properties of Solids
Physics 151L Introductory Mechanics
Physics 152L Introductory Electricity, Magnetism, and Optics
Physics 153L Applications of Physics: A Modern Perspective
Statistics 130 Probability and Statistics in Engineering
Writing 101 Academic Writing

Flowchart of Prerequisites



- blue:** Math
- red:** Physics
- cyan:** Chemistry
- violet:** Biology
- green:** required Engineering courses
- black:** BME Area Core courses
- brown:** BME design courses
- aqua:** BME Area electives (or for matriculating classes of 2015 and later, Advanced Electives with an Area of Focus).
- dashed arrows ---> Co-requisites

Graduation Checklists

The following 8 pages show graduation checklists for BME majors and Second majors for the **Graduating Classes of 2018 and earlier** (matriculating classes of 2014 and earlier; current juniors and seniors) and separately, for the **Graduating Classes of 2019 and later** (matriculating classes of 2015 and later; current sophomores and freshmen). The only difference for the Graduating Classes of 2019 and later is in the BME Elective requirements, which include the new designation "Advanced Elective".

Checklists for other Classes are posted on the BME web site,

<http://www.bme.duke.edu/undergrad/curriculum>.

Find your checklist:

BME Major, Graduating Classes of **2018 and earlier**: p. 45

BME with ECE as a second major, Graduating Classes of **2018 and earlier**: p. 46

BME with CEE as a second major, Graduating Classes of **2018 and earlier**: p. 47

BME with ME as a second major, Graduating Classes of **2018 and earlier**: p. 48

BME Major, Graduating Classes of **2019 and later**: p. 49

BME with ECE as a second major, Graduating Classes of **2019 and later**: p. 50

BME with CEE as a second major, Graduating Classes of **2019 and later**: p. 51

BME with ME as a second major, Graduating Classes of **2019 and later**: p. 52

BME Major

Graduating classes of **2018 and earlier** Course Requirements
(Matriculating classes of 2014 and earlier)

Name

	Term/Yr Taken	Grade	
Writing			
1. Writing 101	_____	_____	
Mathematics and Natural Science			
2. MATH 111L or 21	_____	_____	
3. MATH 112L or 122L or 22	_____	_____	
4. MATH 212*	_____	_____	
5. MATH 216*	_____	_____	
6. MATH 353*	_____	_____	
7. CHEM 101DL or 110DL or 21	_____	_____	
8. CHEM 210DL or 201DL	_____	_____	
9. PHY 151L or 25	_____	_____	
10. PHY 152L or [26 +PHY ____]**	_____	_____	
11. Biology 201L	_____	_____	
12. Life Science Elective*** _____	_____	_____	
Engineering			
13. EGR 103L	_____	_____	
14. ECE 110L	_____	_____	
15. EGR 201L	_____	_____	
16. ME 221L	_____	_____	
17. BME 244L	_____	_____	
18. BME 260L	_____	_____	
19. BME 271 or ECE 280L	_____	_____	
20. BME 354L	_____	_____	
21. BME Design course _____	_____	_____	BME 432L, 436L, 460L, 462L, 464L, or 490L
Area			
22. BME Area Core Class _____	_____	_____	BME 301L, 302L, 303, or 307
23. BME Area Core Class _____	_____	_____	
24. BME Area Elective****	_____	_____	
25. BME Area Elective****	_____	_____	
26. BME General Elective _____	_____	_____	BME General Electives can be at any level.
27. BME General Elective _____	_____	_____	
Humanities and Social Sciences			
28. _____	_____	_____	Five required. At least one SS and 2 from remaining Areas of Knowledge (FL, CZ, ALP). For depth, 2 must be from the same department, and 1 of those must be at the 200 level or higher. Limit of 2 APs.
29. _____	_____	_____	
30. _____	_____	_____	
31. _____	_____	_____	
32. _____	_____	_____	
Electives			
33. _____	_____	_____	
34. _____	_____	_____	

* BME/MATH dual-majors take Math 221+(212 or 222)+356 in place of Math 212+216+353.

** One Physics course must be taken. If AP for both, then Physics 153L is required. Students may not take Physics 151L at Duke and use AP credit for Physics 152L. Students who have IPC instead of AP for both Phys 151L and Phys 152L should take Phys 264.

*** See Table 7 of the BME Undergraduate Program Handbook for the approved Life Science elective courses.

**** Both BME Area Electives must be from the same Area of Focus: BB, EL, IM or MC.

BME with ECE as a Second Major

Graduating classes of **2018 and earlier** Course Requirements
(Matriculating classes of 2014 and earlier)

Name

		Term/Yr Taken	Grade	
Writing				
1.	Writing 101	_____	_____	
Mathematics and Natural Science				
2.	MATH 111L or 21	_____	_____	
3.	MATH 112L or 122L or 22	_____	_____	
4.	MATH 212	_____	_____	
5.	MATH 216	_____	_____	
6.	MATH 353	_____	_____	
7.	STA 130	_____	_____	
8.	CHEM 101DL or 110DL or 21	_____	_____	
9.	CHEM 210DL or 201DL	_____	_____	
10.	PHY 151L or 25	_____	_____	
11.	PHY 152L or [26 + PHY _____]*	_____	_____	
12.	Biology 201L	_____	_____	
13.	Life Science Elective _____	_____	_____	
Engineering				
14.	CompSci 201	_____	_____	
15.	EGR 103L	_____	_____	
16.	EGR 201L	_____	_____	
17.	ME 221L	_____	_____	
18.	ECE 110L	_____	_____	
19.	ECE 230L	_____	_____	
20.	ECE 250L	_____	_____	
21.	ECE 270L	_____	_____	
22.	ECE 280L	_____	_____	
23.	ECE Concentration elective _____	_____	_____	Two approved concentration electives in <i>one</i> area of ECE concentration.
24.	ECE Concentration elective _____	_____	_____	
25.	ECE Elective _____	_____	_____	Any ECE course at 300 level or above.
26.	BME 244L	_____	_____	
27.	BME 260L	_____	_____	
28.	BME 354L	_____	_____	
29.	BME 436L or BME 464L	_____	_____	
Area				
30.	BME 301L or BME 303** _____	_____	_____	
31.	BME Area Elective** _____	_____	_____	
32.	BME General Elective _____	_____	_____	
Humanities and Social Sciences				
Area				
33.	_____	_____	_____	Five required. At least one SS and 2 from remaining areas of knowledge (FL, CZ, ALP). For depth, 2 must be from the same department, and 1 of those must be at the 200 level or higher. Limit of 2 APs.
34.	_____	_____	_____	
35.	_____	_____	_____	
36.	_____	_____	_____	
37.	_____	_____	_____	

* One Duke Physics course must be taken. If AP for both, then Physics 153L is required. Students may not take Physics 151L at Duke and use AP credit for Physics 152L. Students who have IPC instead of AP for both Phys 151L and 152L should take Phys 264.

** If BME 301L is taken, the Area Elective must be from the Electrobiolology (EL) Area.
If BME 303 is taken, the Area Elective must be from the Imaging and Measurement Systems (IM) Area

BME with CEE as a second Major

Graduating classes of **2018 and earlier** Course Requirements

Name _____

(Matriculating classes of 2014 and earlier)

		Term/Yr Taken	Grade	
Writing				
1.	Writing 101	_____	_____	
Mathematics and Natural Science				
2.	MATH 111L or 21	_____	_____	
3.	MATH 112L or 122L or 22	_____	_____	
4.	MATH 212	_____	_____	
5.	MATH 216	_____	_____	
6.	MATH 353	_____	_____	
7.	STA 130	_____	_____	
8.	CHEM 101DL or 110L or 21	_____	_____	
9.	CHEM 210DL or 201DL	_____	_____	
10.	PHY 151L or 25	_____	_____	
11.	PHY 152L or [26 + PHY _____]*	_____	_____	
12.	Biology 201L	_____	_____	
13.	Life Science Elective** _____	_____	_____	
Engineering				
14.	EGR 103L	_____	_____	
15.	EGR 201L	_____	_____	
16.	EGR 244L	_____	_____	
17.	EGR 305	_____	_____	
18.	ME 221L	_____	_____	
19.	ECE 110L	_____	_____	
20.	BME 244L	_____	_____	
21.	BME 260L	_____	_____	
22.	BME 271 or ECE 280L	_____	_____	
23.	BME 354L	_____	_____	
24.	BME/CEE Design course: _____	_____	_____	CEE 469, BME 427L, or BME 462L
Area				
25.	BME 302L or BME 307** _____	_____	_____	
26.	BME Area elective** _____	_____	_____	
27.	CEE 201L	_____	_____	
28.	CEE 301L	_____	_____	
29.	CEE 461L	_____	_____	
30.	CEE 462L	_____	_____	
31.	CEE 463L	_____	_____	
32.	CEE elective*** _____	_____	_____	
Humanities and Social Sciences				
33.	_____	_____	_____	Five required. At least one SS and at least 2 from the 3 remaining areas of knowledge (FL, CZ, ALP). For depth, two must be from the same department, and at least one of those must be at the 200 level or higher. Limit 2 APs.
34.	_____	_____	_____	
35.	_____	_____	_____	
36.	_____	_____	_____	
37.	_____	_____	_____	

* One Duke Physics course must be taken. If AP for both, then Physics 153L is required. Students may not take Physics 151L at Duke and use AP credit for Physics 152L. Students who have IPC instead of AP for both Phys 151L and 152L should take Phys 264.

** If BME 302L is taken, the Area Elective must come from the Biomaterials/Biomechanics (BB) Area.

If BME 307 is taken, the Area Elective must come from the Molecular, Cellular and Tissue Engineering (MC) Area.

*** CEE 661L, 563, 564, 561, 671, 562, 581, 685, 575, 672, 571.

BME with ME as a second major

Graduating classes of **2018 and earlier** Course Requirements
(Matriculating classes of 2014 and earlier)

Name _____

	Term/Yr Taken	Grade
Writing		
1. Writing 101	_____	_____
Mathematics and Natural Science		
2. MATH 111L or 21	_____	_____
3. MATH 112L or 122L or 22	_____	_____
4. MATH 212	_____	_____
5. MATH 216	_____	_____
6. MATH 353	_____	_____
7. CHEM 101DL or 110DL or 21	_____	_____
8. CHEM 210DL or 201DL	_____	_____
9. PHY 151L or 25	_____	_____
10. PHY 152L or [26 + PHY _____]*	_____	_____
11. Biology 201L	_____	_____
12. Life Science Elective _____	_____	_____
Engineering		
13. EGR 103L	_____	_____
14. EGR 201L	_____	_____
15. EGR 121L	_____	_____
16. EGR 244L	_____	_____
17. ECE 110L	_____	_____
18. BME 244L	_____	_____
19. BME 260L	_____	_____
20. BME 271 or ECE 280L	_____	_____
21. BME 354L	_____	_____
22. BME 302L	_____	_____
23. BME/ME Design course ** _____	_____	_____
24. BME Biomech/Biomat Area elective*** _____	_____	_____
25. ME 221L	_____	_____
26. ME 321L	_____	_____
27. ME 331L	_____	_____
28. ME 336L	_____	_____
29. ME 344L	_____	_____
30. ME 421L	_____	_____
31. ME 431L	_____	_____
32. ME elective 1 _____	_____	_____
33. ME elective 2 _____	_____	_____
Humanities and Social Sciences		
34. _____	_____	_____
35. _____	_____	_____
36. _____	_____	_____
37. _____	_____	_____
38. _____	_____	_____

One Physics course must be taken. If AP for both, then Physics 153L is required.

Five required. At least one SS and 2 from remaining areas of knowledge (FL, CZ, ALP). For depth, two must be from the same department, and one of those must be at the 200 level or higher. Limit of 2 APs.

* One Physics course must be taken. If AP for both, then Physics 153L is required. Students may not take Physics 151L at Duke and use AP credit for Physics 152L. Students who have IPC instead of AP for both Phys 151L and 152L should take Phys 264.

** ME 424L with BME project.

*** Listed in Tables 5-6 of the BME Undergraduate Program Handbook

BME Major

Graduating classes of **2019 and later** Course Requirements
(Matriculating Classes of 2015 and later)

Name _____

		Term/Yr Taken	Grade	
Writing				
1.	Writing 101	_____	_____	
Mathematics and Natural Science				
2.	MATH 111L or 21	_____	_____	
3.	MATH 112L or 122L or 22	_____	_____	
4.	MATH 212*	_____	_____	
5.	MATH 216*	_____	_____	
6.	MATH 353*	_____	_____	
7.	CHEM 101DL or 110DL or 21	_____	_____	
8.	CHEM 210DL or 201DL	_____	_____	
9.	PHY 151L or 25	_____	_____	
10.	PHY 152L or [26 + PHY _____]**	_____	_____	
11.	Biology 201L	_____	_____	
12.	Life Science Elective*** _____	_____	_____	
Engineering				
13.	EGR 103L	_____	_____	
14.	ECE 110L	_____	_____	
15.	EGR 201L	_____	_____	
16.	ME 221L	_____	_____	
17.	BME 244L	_____	_____	
18.	BME 260L	_____	_____	
19.	BME 271 or ECE 280L	_____	_____	
20.	BME 354L	_____	_____	
21.	BME Design course _____	_____	_____	BME 432L, 436L, 460L, 462L, 464L, or 490L
Area				
22.	BME Area Core Class _____	_____	_____	BME 301L, 302L, 303, or 307
23.	BME Area Core Class _____	_____	_____	
24.	BME Advanced Elective****	_____	_____	
25.	BME Advanced Elective****	_____	_____	
26.	BME Advanced Elective _____	_____	_____	
27.	BME General Elective***** _____	_____	_____	
Humanities and Social Sciences				
Area				
28.	_____	_____	_____	Five required. At least one SS and 2 from remaining Areas of Knowledge (FL, CZ, ALP). For depth, two must be from the same department, and one of those must be at the 200 level or higher. Limit of 2 APs.
29.	_____	_____	_____	
30.	_____	_____	_____	
31.	_____	_____	_____	
32.	_____	_____	_____	
Electives				
33.	_____	_____	_____	
34.	_____	_____	_____	

* BME/MATH dual-majors take Math 221+(212 or 222)+356 in place of Math 212+216+353.
 ** One Physics course must be taken. If AP for both, then Physics 153L is required. Students may not take Physics 151L at Duke and use AP credit for Physics 152L. Students who have IPC instead of AP for both Phys 151L and Phys 152L should take Phys 264.
 *** See Table 7 of the BME Undergraduate Program Handbook for the approved Life Science elective courses.
 **** Two of the Advanced Electives must be from the same Area of Focus (BB, EL, IM or MC) as one of the Area Core Classes taken.
 ***** An Advanced Elective may be taken instead.

BME with ECE as a Second Major

Graduating classes of **2019 and later** Course Requirements
(Matriculating Classes of 2015 and later)

		Name
	Term/Yr Taken	Grade
Writing		
1. Writing 101	_____	_____
Mathematics and Natural Science		
2. MATH 111L or 21	_____	_____
3. MATH 112L or 122L or 22	_____	_____
4. MATH 212	_____	_____
5. MATH 216	_____	_____
6. MATH 353	_____	_____
7. STA 130	_____	_____
8. CHEM 101DL or 110DL or 21	_____	_____
9. CHEM 210DL or 201DL	_____	_____
10. PHY 151L or 25	_____	_____
11. PHY 152L or [26 + PHY _____]*	_____	_____
12. Biology 201L	_____	_____
13. Life Science Elective _____	_____	_____
Engineering		
14. CompSci 201	_____	_____
15. EGR 103L	_____	_____
16. EGR 201L	_____	_____
17. ME 221L	_____	_____
18. ECE 110L	_____	_____
19. ECE 230L	_____	_____
20. ECE 250L	_____	_____
21. ECE 270L	_____	_____
22. ECE 280L	_____	_____
23. ECE Concentration elective _____	_____	_____
24. ECE Concentration elective _____	_____	_____
25. ECE Elective _____	_____	_____
26. BME 244L	_____	_____
27. BME 260L	_____	_____
28. BME 354L	_____	_____
29. BME 436L or BME 464L	_____	_____
Area		
30. BME 301L or BME 303** _____	_____	_____
31. BME Advanced Elective** _____	_____	_____
32. BME General Elective*** _____	_____	_____
Humanities and Social Sciences		
Area		
33. _____	_____	_____
34. _____	_____	_____
35. _____	_____	_____
36. _____	_____	_____
37. _____	_____	_____

Two approved concentration elective in *one* area of ECE concentration.

Any ECE course at 300 level or above.

Five required. At least one SS and 2 from remaining areas of knowledge (FL, CZ, ALP). For depth, two must be from the same department, and one of those must be at the 200 level or higher. Limit of 2 APs.

* One Duke Physics course must be taken. If AP for both, then Physics 153L is required. Students may not take Physics 151L at Duke and use AP credit for Physics 152L. Students who have IPC instead of AP for both Phys 151L and 152L should take Phys 264.

** If BME 301L is taken, the Advanced Elective must be from the Electrobiolology (EL) Area of Focus.
If BME 303 is taken, the Advanced Elective must be from the Imaging and Measurement Systems (IM) Area of Focus.

*** An Advanced Elective may be taken instead.

BME with CEE as a second Major

Graduating classes of **2019 and later** Course Requirements
(Matriculating Classes of 2015 and later)

Name _____

		Term/Yr Taken	Grade	
Writing				
1.	Writing 101	_____	_____	
Mathematics and Natural Science				
2.	MATH 111L or 21	_____	_____	
3.	MATH 112L or 122L or 22	_____	_____	
4.	MATH 212	_____	_____	
5.	MATH 216	_____	_____	
6.	MATH 353	_____	_____	
7.	STA 130	_____	_____	
8.	CHEM 101DL or 110L or 21	_____	_____	
9.	CHEM 210DL or 201DL	_____	_____	
10.	PHY 151L or 25	_____	_____	
11.	PHY 152L or [26 + PHY _____]*	_____	_____	
12.	Biology 201L	_____	_____	
13.	Life Science Elective** _____	_____	_____	
Engineering				
14.	EGR 103L	_____	_____	
15.	EGR 201L	_____	_____	
16.	EGR 244L	_____	_____	
17.	EGR 305	_____	_____	
18.	ME 221L	_____	_____	
19.	ECE 110L	_____	_____	
20.	BME 244L	_____	_____	
21.	BME 260L	_____	_____	
22.	BME 271 or ECE 280L	_____	_____	
23.	BME 354L	_____	_____	
24.	BME/CEE Design course: _____	_____	_____	CEE 469, BME 427L, or BME 462L
Area				
25.	BME 302L or BME 307** _____	_____	_____	
26.	BME Advanced Elective** _____	_____	_____	
27.	CEE 201L	_____	_____	
28.	CEE 301L	_____	_____	
29.	CEE 461L	_____	_____	
30.	CEE 462L	_____	_____	
31.	CEE 463L	_____	_____	
32.	CEE elective*** _____	_____	_____	
Humanities and Social Sciences				
33.	_____	_____	_____	Five required. At least one SS and at least 2 from the 3 remaining areas of knowledge (FL, CZ, ALP). For depth, two must be from the same dept., and at least one of those must be at the 200 level or higher. Limit 2 APs.
34.	_____	_____	_____	
35.	_____	_____	_____	
36.	_____	_____	_____	
37.	_____	_____	_____	

* One Duke Physics course must be taken. If AP for both, then Physics 153L is required. Students may not take Physics 151L at Duke and use AP credit for Physics 152L. Students who have IPC instead of AP for both Phys 151L and 152L should take Phys 264.

** If BME 302L is taken, the Area Elective must come from the Biomaterials/Biomechanics (BB) Area of Focus. If BME 307 is taken, the Area Elective must come from the Molecular, Cellular and Tissue Engineering (MC) Area of Focus.

*** CEE 661L, 563, 564, 561, 671, 562, 581, 685, 575, 672, 571.

BME with ME as a second major
Graduating classes of 2019 and later Course Requirements
 (Matriculating Classes of 2015 and later)

		Term/Yr Taken	Grade	Name _____
Writing				
1.	Writing 101	_____	_____	
Mathematics and Natural Science				
2.	MATH 111L or 21	_____	_____	
3.	MATH 112L or 122L or 22	_____	_____	
4.	MATH 212	_____	_____	
5.	MATH 216	_____	_____	
6.	MATH 353	_____	_____	
7.	CHEM 101DL or 110DL or 21	_____	_____	
8.	CHEM 210DL or 201DL	_____	_____	
9.	PHY 151L or 25	_____	_____	One Physics course must be taken. If AP for both, then Physics 153L is required.
10.	PHY 152L or [26 + PHY _____]*	_____	_____	
11.	Biology 201L	_____	_____	
12.	Life Science Elective _____	_____	_____	
Engineering				
13.	EGR 103L	_____	_____	
14.	EGR 201L	_____	_____	
15.	EGR 121L	_____	_____	
16.	EGR 244L	_____	_____	
17.	ECE 110L	_____	_____	
18.	BME 244L	_____	_____	
19.	BME 260L	_____	_____	
20.	BME 271 or ECE 280L	_____	_____	
21.	BME 354L	_____	_____	
22.	BME 302L	_____	_____	
23.	BME/ME Design course** _____	_____	_____	
24.	BME Advanced Elective in BB Area*** _____	_____	_____	
25.	ME 221L	_____	_____	
26.	ME 321L	_____	_____	
27.	ME 331L	_____	_____	
28.	ME 336L	_____	_____	
29.	ME 344L	_____	_____	
30.	ME 421L	_____	_____	
31.	ME 431L	_____	_____	
32.	ME elective 1 _____	_____	_____	
33.	ME elective 2 _____	_____	_____	
Humanities and Social Sciences				
34.	_____	_____	_____	Five required. At least one SS and 2 from remaining areas of knowledge (FL, CZ, ALP). For depth, two must be from the same department, and one of those must be at the 200 level or higher. Limit of 2 APs.
35.	_____	_____	_____	
36.	_____	_____	_____	
37.	_____	_____	_____	
38.	_____	_____	_____	

* One Physics course must be taken. If AP for both, then Physics 153L is required. Students may not take Physics 151L at Duke and use AP credit for Physics 152L. Students who have IPC instead of AP for both Phys 151L and 152L should take Phys 264.
 ** ME 424L with BME project.
 *** Listed in Tables 5-6 of the BME Undergraduate Program Handbook

NOTES