

**Vanderbilt University
School of Engineering**

**Biomedical Engineering
Undergraduate Curriculum Guide**

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Welcome to the study of biomedical engineering at Vanderbilt University. The mission of our department encompasses that of the Vanderbilt School of Engineering, which is to provide a high quality education in selected areas of engineering, balanced with broad learning opportunities from other fields, and integrated to provide intellectual richness and flexibility. Expanding upon this, it is the mission of the Vanderbilt Department of Biomedical Engineering to –

- Enlighten our students with the engineering, mathematics and basic sciences that advance health care and biotechnology;
- Develop the reasoning faculties of our students, enlarge their minds and instill in them precepts of accuracy, ethics and enterprise; and
- Form the engineers, physicians, scientists and industrialists upon whose leadership continued progress in scientific understanding, health and industry depend.

The objectives of the Vanderbilt undergraduate program in biomedical engineering are the following:

- To provide an educational program focused at the interface of engineering and biology that enables graduates to solve technological problems and contribute to human health through the practice of biomedical engineering or related fields.
- To provide an educational program with breadth sufficient to instill in graduates knowledge of their professional and ethical responsibilities, knowledge in liberal arts, and skills in effective communication that they will carry into their post-baccalaureate endeavors.
- To prepare students for programs of advanced study in engineering, the sciences or medicine, or placement in the health-care, biomedical device, and biotechnology industries or as practitioners in related fields.

To achieve these objectives, the BME faculty has designed the curriculum described in this guide. If you follow this curriculum, the objectives above will be met for you specifically and you will be prepared for the next stage of your life as a biomedical engineer. In particular, this curriculum is designed to provide you with the following outcomes:

- An ability to apply knowledge of mathematics, science, and engineering at the interface of engineering and biology.
- An ability to design and conduct experiments, including experiments on living systems.
- An ability to analyze and interpret data, including data from measurements on living systems.
- An ability to design a system, component, or process to meet desired needs, including systems involving the interaction of living and non-living states, within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- An ability to function on multi-disciplinary teams.

- An ability to identify, formulate, and solve engineering problems, including problems at the interface of engineering and biology.
- An understanding of professional and ethical responsibility.
- An ability to communicate effectively, in writing (g1) and by speaking (g2).
- The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
- A recognition of the need for and an ability to engage in life-long learning.
- A knowledge of contemporary issues.
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice and be prepared for further education in engineering, medicine, or biomedical science.

As is the case for most things worth learning, biomedical engineering as a field is too broad to cover in its entirety in an undergraduate curriculum. BME spans a wide range of particular interests from devices that allow us to see inside the body without opening it to systems of equations that provide insight into how the circulatory system responds to changes in cardiac function; from the observation and determination of how microscopic cells and groups of cells control macroscopic events to management of the information flow in a medical center. While you may choose to focus on a particular part of BME, a working knowledge of other material is essential. Consequently, our curriculum will provide you the broad fundamentals of biomedical engineering and then allow you the flexibility to concentrate on your particular area of interest in your junior and senior years. Rather than being forced to choose from fixed specialty tracks, the curriculum gives you the opportunity to build on required core knowledge and explore and define your own area(s) of concentration for higher level study.

This guide, along with more information about our faculty and programs, can be found at our web site, www.bme.vanderbilt.edu. The roster of faculty, basic curriculum and descriptions of all classes are found in the Undergraduate Catalog, also known as The Bulletin, published annually by the University in hard copy and online at <http://www.vanderbilt.edu/catalogs/undergrad/>.

Please note that our curriculum is not static. Consult with your academic adviser regarding changes to the curriculum and how they apply to you.

General Guidelines

1. **Student Responsibility.** The student, not his or her adviser, is responsible for seeing that he or she has fulfilled all the requirements for graduation. The adviser's role is as a co-conspirator in the success of the student.
2. The **Undergraduate Catalog** (also known as "The Bulletin of Vanderbilt University") contains all official information related to degree requirements. It is available in hard copy and online at <http://www.vanderbilt.edu/catalogs/undergrad/index.html>. In case of any conflict between the Catalog and this guide, the Undergraduate Catalog shall prevail.
3. **Credit Hours.** BME majors need credit hours as allocated in the table below to graduate.

	Credit Hours
Mathematics	15
Basic Sciences	24
Introductory engineering & computing	6
Electrical engineering	7
BME core	31
BME electives	11
Science, engineering, math (SEM) electives	9
Liberal Arts Core	18
Open electives	6
Total hours	127

4. **Seminars.** Students are encouraged to take a freshman engineering seminar course (1 credit hour) in the first year, although it is not required. Students who take these courses generally enjoy them and benefit from early exposure to engineering. Several deal with topics in biomedical engineering.
5. **Core Curriculum.** The required courses that comprise the core curriculum are shown as explicitly listed courses in the detailed curricula on Page 10 and, for BME/EE double majors, on Pages 14 to 15. While there is some flexibility, the course sequence is laid out to ensure that students will have the necessary prerequisites for each course and will not encounter scheduling conflicts for required courses. Should you, by choice or by necessity, find yourself using a different sequence for completing these courses, pay careful attention to prerequisites, corequisites, and schedulability.
6. **Basic Sciences.** The core curriculum includes a basic science requirement (24 hours) consisting of Chemistry 102a–b, 104a-b, 106a-b, Physics 116a-b, 118a-b, Biological Sciences 110/111a, and a second approved biological sciences course with lab. For the second biological science course, students may choose from BSCI 110b/111b, BSCI 110b/111c, BSCI 201/202, BSCI 210/211, BSCI 220/221, or BSCI 252/253. While many of the course options listed officially require BSCI 110b/111b

as a prerequisite, the Biological Sciences Department has assured us that our students may take these courses if they have completed BSCI 110a/111a and BME 251, which are requirements for our students. This may require some rearrangement of an individual student's course schedule.

7. **Program Electives.** Twenty hours of program electives are required. Of these, at least 11 hours must be BME electives with no more than a total of 3 credit hours from BME 240 and 241 combined. The remaining nine hours may be selected from either BME or SEM electives listed on pages 11 - 13. Students should work with their advisers to select electives that will best prepare them for the next stages of their careers. Courses taken to fulfill the program elective requirement may not be taken pass/fail.
8. **Liberal Arts Core.** In order to provide the elements of a general education considered necessary for responsible practice as an educated engineer, the School of Engineering requires each student complete at least 18 hours in the Liberal Arts Core. The Liberal Arts Core will be selected from courses in the five distribution categories designated in the AXLE Curriculum Course Distribution of the College of Arts and Science:
 - a) Humanities and the Creative Arts
 - b) International Cultures, including Arabic 210a, Chinese 201, French 101a, German 101, Greek 201, Hebrew 111a, Italian 101a, Japanese 200ab and 201, Latin 101, Portuguese 100a, Russian 101, Spanish 100 and 101
 - c) History and Culture of the United States
 - d) Social and Behavioral Sciences
 - e) Perspectives

and the distribution categories of:

- f) Music Composition and Performance: All MUSC, MUSE, MUSO, and MUSP courses in the Blair School of Music.
- g) Cognition and Development: All Peabody College courses in Psychology and Human Development numbered 1200-2000, 2230-2470, and 2560-2610, and in Human and Organizational Development numbered 1000, 1100, 1200-1800, and 2240-2280
- h) Technology in Society: Computer Science 151, Engineering Management 150, 244, 275, Engineering Science 153, 155, 157, Environmental Engineering 296

Within the 18-hour requirement, the student must meet the following distribution requirements:

- At least 3 credit hours in each of at least three different categories
- At least 6 credit hours in one of categories a) to g)
- At most 3 credit hours of Technology in Society courses

9. **Open Electives.** These credit hours allow students to explore an area of interest that may or may not be related to BME. Freshmen engineering seminars carry 1

hour of open elective credit and are recommended, as are additional courses in engineering. Many courses excluded from the liberal arts core listings may be counted only as open electives. Officer education courses Military Science 113, 151, 152, and Naval Science 121, 231 and 241 may be taken as open electives. AFROTC students may count 6 hours of their military courses as open electives. No other officer education courses earn credit toward a degree.

10. **Study Abroad.** Students interested in study abroad during the academic year (rather than a summer semester program) should begin planning early to deal with the challenges presented by sequences of courses that are not offered every semester. Note that there are many international BME programs suitable for study abroad. Contact the Global Education Office (<http://www.vanderbilt.edu/geo/>) or see the Study Abroad page (under "Students") on the VUSE website for more information.
11. **AP, IB, and Transfer Credits.** Advanced Placement, International Baccalaureate, and transfer credits can be applied toward certain requirements for your BME degree if the specific credits are found to be acceptable by the faculty and the VUSE Academic Counselor, Mr. Steve Wadley, in the School of Engineering's Office of Student Services. Requests for transfer credit for non-Vanderbilt courses commencing after matriculation at Vanderbilt require pre-approval by your adviser. Transfer credit is not accepted for BME courses except in the case of study abroad. In that case, the Global Education Office and BME faculty members will work to help you find courses equivalent to our BME courses in advance of your time abroad.
12. **Graduate School Preparation / Professional Preparation.** The BME curriculum should prepare you for graduate school or professional practice. Consult with your adviser to plan your electives to suit your career goals. Students planning to take the Graduate Record Examination (GRE) in anticipation of applying to graduate school are encouraged to strengthen verbal skills by taking courses with significant non-technical reading, by reading for pleasure and by studying vocabulary frequently.
13. **Medical School Preparation.** Biomedical engineering is a rigorous path for entry into, and an excellent preparation for strong performance in, graduate study in medicine for those students willing and able to excel in mathematics, physics, chemistry, biology, physiology and engineering. If you are considering medical school, please note the following:
 - a) Premeds take organic chemistry with lab as eight of their SEM Elective hours.
 - b) We recommend that premeds consider deferring BME 210 until their senior year if taking organic chemistry in the junior year. We strongly recommend that premeds not pursue a double major.
 - c) Premeds must complete two English courses before entering medical school, and an English writing ("W") course is particularly recommended. Such courses count toward the LAC requirement. The required BME 255W course may usually be counted as the second "English" course for most medical schools.
 - d) Premeds are also encouraged to take additional biology courses (e.g., zoology, developmental biology, etc.), either as SEM electives or open electives.

- e) The Health Professions Advising Office (HPAO) offers additional guidance and support to students preparing for medical school and should be contacted early in the degree program.
 - f) While AP credits are generally accepted toward the undergraduate degree, many medical schools do not accept AP credits when evaluating applicants' credentials. So, while for example you may have AP credit for Chem 102a/104a, you may wish to forgo that credit by taking Chem 102a/104a here. If you do accept AP credit for chemistry (Chem 102a/104a), you must take additional chemistry credit hours (e.g., bioorganic chemistry or medicinal chemistry) to meet premed requirements.
 - g) Our curriculum will prepare students to apply to nearly all medical schools. However, students should be aware that some medical schools have additional requirements. Check with the HPAO regarding any unique requirements.
14. **Honors.** With approval of the Honors Program Director, Prof. Cynthia B. Paschal, juniors and seniors in biomedical engineering who have achieved a minimum quality point ratio of 3.5 may be accepted into the undergraduate honors program. Honors students take at least six credit hours of 300-level (graduate) BME courses, which can be counted toward the undergraduate degree requirements as BME electives or which can be taken for graduate school credit. Students in the honors program must also complete a two semester-long research project and present a research report; this is generally accomplished through the BME 240a and 240b Undergraduate Research elective courses. Honors students must make a quality point ratio of 3.0 in these classes and maintain an overall 3.5 GPA to be designated as an honors graduate. The diploma designation is Honors in Biomedical Engineering.
15. **Internships.** The experience of working as an intern in a biomedical engineering firm or research laboratory can be an invaluable component of your education and preparation for future employment. Such an experience strengthens the understanding of concepts learned in the classroom, teaches valuable workplace skills, and provides insight into future career options. Summer internships are strongly encouraged, especially for rising juniors and seniors. Please see your academic adviser for guidance no later than January of the year in which you wish to participate in an internship.
16. **Double majors.** At present, there are two formal double majors within the School of Engineering, one with electrical engineering and one with chemical engineering. The double major with electrical engineering is detailed on pages 14-15 of this guide; students considering the BME/EE double major are urged to consult with the BME/EE double major adviser, Prof. A.B. Bonds. Students interested in the BME/ChE double major should consult with Prof. Adam Anderson regarding requirements and details of scheduling. Occasionally students choose a double major with a program in the College of Arts and Science, Peabody College, or in the Blair School of Music. In such cases, students must meet the requirements of both programs, which generally requires advanced placement credits, summer study, and/or extra semester(s). Students must declare their intention to double major by completing the appropriate form available in the School of Engineering Office of Student Services.

17. **Minors.** There are four approved minors in the School of Engineering: Computer Science, Environmental Engineering, Materials Science, and Engineering Management. Students wishing to pursue these minors can spend their allotted hours of SEM and open electives towards these minors. Please see the Undergraduate Catalog for sequences. Other minors outside the School of Engineering are possible and students are encouraged to consult the Undergraduate Catalog and faculty in the program of interest for minor requirements. Students must declare their intention to add a minor by completing the appropriate form available in the School of Engineering Registrar's office.
18. **Combined five-year bachelor's/master's degree program.** Advanced students with a passion for research may be able to complete the requirements for both the bachelor's degree (127 credit hours) and master's degree (24 credit hours + thesis) in BME within five years. The first step is to talk with your academic adviser in the sophomore or early junior year about the appropriateness and feasibility of a combined BE/MS program for your career goals. Interested students should then proceed by discussing program details, including application timing, with the BME Director of Graduate Studies, Prof. E. Duco Jansen.

Biomedical Engineering Curriculum

Fall	First Year				Spring
Chem 102/4/6a	General Chem & Lab, Rec	4	Chem 102/4/6b	General Chem & Lab, Rec	4
ES 140	Introduction to Engineering	3	CS 103 ¹	Programming: Matlab	3
LAC	LAC Elective	3	Math 155b	Calculus	4
Math 155a	Calculus	4	Phys116a,118a	General Physics	4
ES 101	Seminar (optional)	1	Total Hours		15
Total Hours		15			

Fall	Sophomore Year				Spring
BME 101	Biomechanics	3	BME 103	Biomaterials	3
BSCI 110a, 111a	Intro to Biological Sci.	4	BSCI xxx ²	Choice of 2 nd BSCI w/ lab	4
LAC	LAC Elective	3	EECE 112	Circuits I	3
Math 175	Calculus	3	LAC	LAC Elective	3
Phys 116b, 118b	General Physics	4	Math 196 ³	Diff Eqns & Linear Alg	4
Total Hours		17	Total Hours		17

Fall	Junior Year				Spring
BME 210	Physiological Transport	3	BME 252	Systems Physiology	3
BME 251	Systems Physiology	3	BME 260	Analysis of BME Data	3
EECE 213, 213L	Circuits II	4	BME 271	Medical Instrumentation	4
BME/SEM	BME/SEM Elective ⁴	3-4	BME/SEM	BME/SEM Elective ⁴	3-4
Open	Open Elective	3	LAC	LAC Elective	3
Total Hours		16-17	Total Hours		16-17

Fall	Senior Year				Spring
BME 255W	BME Laboratory	3	BME 273	Design of BME Devices	3
BME 272	Design of BME Devices and Systems I	2	BME/SEM	and Systems II	
BME 297	Sr Engr Design Seminar	1	BME/SEM	BME/SEM Elective ⁴	3-4
BME/SEM	BME/SEM Elective ⁴	3	LAC	BME/SEM Elective ⁴	3
BME/SEM	BME/SEM Elective ⁴	3-4	Open	LAC Elective	3
LAC	LAC Elective	3	Total Hours		15-16
Total Hours		15-16			

Hours required to graduate = 127

Notes:

1. Students with a strong desire to study C++ will be allowed to substitute a three-credit hour C++ course as long as they hold themselves responsible for learning the Matlab skills required in later courses. Note that CS 103 is a prerequisite for BME 101.
2. To complete the biological sciences requirement, students must take one of these courses with a lab: BSCI 110b/111b, BSCI 110b/111c, BSCI 201/202, BSCI 210/211, BSCI 220/221, BSCI 252/253. If one of the 200-level BSCI courses is chosen, it will need to be taken after both BSCI 110a/111a and BME 251 are completed (e.g., spring of the junior or senior year).
3. Math 196 is the required course, though a combination of BOTH Math 198 and either Math 194 or 204 may be substituted with the extra math hours counting as SEM electives.
4. BME students take at least 11 credit hours of BME program electives and nine credit hours of SEM (science, engineering, math) electives. See following pages for elective options.

Program Electives

BME ELECTIVES

A total of 11 BME elective hours must be taken. BME Electives are elective courses taught within the BME department and carrying a "BME" course code at the 200-level and higher (e.g., BME 285).

- BME graduate courses, with the exception of BME 391-394, may be taken as electives provided the student has a 3.5 GPA and appropriate permissions.
- BME freshman seminars and any BME Technology & Society electives regardless of course number, such as BME 201 Biomedical Ethics, cannot count as BME electives.
- Up to three credit hours total of BME 240 and 241 may count as a BME elective; an additional three hours of BME 240/241 may be used as SEM electives.
- BME students may count up to three hours of the following VUSE courses as BME electives: ChE 282, ChE 283, ChE 287, CS 253/EECE 253, EECE 214, EECE 254, ENVE 272, ENVE 269, and ME 220a. This option does not apply to BME/EE double majors.
- Note: BME elective credit hours in excess of 11 will be counted as SEM electives.

SEM ELECTIVES

A total of nine hours of Science, Engineering, Math (SEM) electives must be taken. SEM electives include BME electives taken above the 11 hour minimum, up to three credit hours of BME 240 or 241 combined, other courses in the School of Engineering except as noted below, organic chemistry (all eight hours), and courses in the sciences and math listed on the following pages or as pre-approved in writing by your academic adviser and the BME Director of Undergraduate Studies. Graduate courses in suitable fields may be taken as SEMs provided the student has a 3.5 GPA and appropriate permissions.

School of Engineering SEM Electives

Note: Freshman seminars may not be taken for SEM elective credit.

Note: With the exception of ENGM 244 and ENGM 275, Technology & Society electives may not be taken for SEM elective credit.

Note: Engineering Sciences courses may not be taken for SEM elective credit.

BME 240b Senior Research 1-3 Fall, Spring, & Summer

BME 241b Undergraduate Projects in BME Ed. 1-3 Fall, Spring, & Summer

Any course in Chemical Engineering except ChE 230

Any course in Civil & Environmental Engineering except CE 180

Any course in Computer Science except CS151

Any course in Electrical and Computer Engineering

Any course in Engineering Management except ENGM 150

Any course in Materials Science

Any course in Mechanical Engineering except ME 171

Again, note the restrictions above on freshman seminars and Technology-Society electives.

College of Arts and Science & School of Nursing SEM Electives

Acceptance for SEM elective credit of other physical science and mathematics courses not on this list but that are relevant to biomedical engineering requires written pre-approval by your adviser and the BME Director of Undergraduate Studies.

Biological Sciences

BSCI courses from the following list, taken in addition to those used to fulfill the basic sciences curriculum requirement, may be counted as SEM electives.

Course	Title of Course (Prerequisites)	Credit Hours	Fall, Spring, Summer
BSCI 110b	Intro to Biological Sciences	3	Spring
BSCI 111b	Biological Sciences Lab	1	Spring
BSCI 111c	Biological Sciences Lab	1	Spring
BSCI 201	Intro to Cell Bio (110a, 110b)	3	Spring
BSCI 202	Cell Bio Lab (201 or concurrent)	1	Spring
BSCI 210	Principles of Genetics (110a, b)	3	Spring
BSCI 211	Genetics lab (210 or concurrent)	1	Spring
BSCI 220	Biochemistry I (110a,b Chem 220a,b)	3	Fall, Spring
BSCI 226	Intro to Immunology (201 or 210)	3	Spring
BSCI 240	Developmental Biology (201 & 210)	3	Fall
BSCI 247	Molecular Evolution	3	Spring
BSCI 252	Cellular Neurobiology	3	Spring
BSCI 253	Lab in Neurobiology (111a,b)	1	Spring
BSCI 256	Molecular Neurobiology	3	Fall
BSCI 274	Protein Design	3	Spring

Chemistry

CHEM 218ab/219ab or 220ab/219ab organic chemistry is required for premeds.

Course	Title of Course	Credit Hours	Fall, Spring, Summer
CHEM 220a/b	Organic Chemistry I & II	3,3	Fall, Spring
CHEM 218a/b	Organic Chemistry I & II	3,3	Fall, Spring
CHEM 219a/b	Organic Chemistry Laboratory I & II	1,1	Fall, Spring
CHEM 207	Intro. To Organometallic Compounds	3	Spring
CHEM 227W	Forensic Analytical Chemistry	3	Spring
CHEM 230	Physical Chemistry I	3	Fall
CHEM 231	Physical Chemistry II	3	Spring
CHEM 222	Physical Organic Chemistry	3	Spring
CHEM 220c	Organic Chemistry and Mechanism	3	Fall
CHEM 202	Intro. To Bioinorganic Chemistry	3	Spring
CHEM 224	Bioorganic Chemistry	3	Fall
CHEM 225	Spect. Identification of Org. Comp.	3	Fall
CHEM 226	Medicinal Chemistry	3	Fall
CHEM 233	Molecular Modeling Methods	3	Spring
CHEM 234	Spectroscopy	3	Spring
CHEM 236	Physical Chemistry Laboratory	1	Fall
CHEM 237	Experimental Spectroscopy	2	Spring
CHEM 250	Chemical Literature	1	Spring

Math

All 200 level mathematics courses, with the exception of MATH 208, 216, 218, and 252, are accepted as SEM Electives. Suggested courses include the following:

Course	Title of Course	Credit Hours	Fall, Spring, Summer?
MATH 226*	Introduction to Numerical Mathematics *BME students should take this as CS 255.	3	Fall, Spring
MATH 229	Advanced Engineering Mathematics	3	Spring
MATH 234	Methods for Initial and Boundary Value Problems	3	Fall, Spring
MATH 261	Complex Variables	3	Spring
MATH 290	Introductory Analysis	4	Spring
MATH 294	Partial Differential Equations	3	Fall

Neuroscience

Course	Title of Course (Prerequisite)	Credit Hours	Fall, Spring, Summer?
NSC 201	Neuroscience	3	Fall, Spring
NSC 255	Integrative Neuroscience (NSC 201)	3	Spring

Nursing

Course	Title of Course	Credit Hours	Fall, Spring, Summer?
NURS 150	Introduction to Microbiology	3-4	Spring
NURS 225	Population Based Health Care	2	Fall
NURS 231a,b	Nutrition	2, 1	Fall, Spring

Physics

Course	Title of Course	Credit Hours	Fall, Spring, Summer?
PHYS 223	Thermal and Statistical Physics	3	Fall
PHYS 225W	Intro Quantum Physics & Applications I	4	Fall
PHYS 228*	Physics of Medical Imaging *Credit allowed for only one of BME 258 or PHYS 228.	3	Fall
PHYS 229a,b	Electricity, Magnetism & Electrodynamics	3	Fall, Spring
PHYS 243	Health Physics	3	Fall
PHYS 248	Radiation Biophysics	2	Spring

Psychology

Course	Title of Course	Credit Hours	Fall, Spring, Summer?
PSY 234	Laboratory in Behavioral Neuroscience	3	Fall, Spring
PSY 236*	Visual System *BME students should take this as EECE 225	3	Spring
PSY 279	Chemistry of the Brain	3	Spring

Biomedical Engineering / Electrical Engineering Double Major

There are three pathways for the first two years of this double major; each requires completion of the same requirements but in a different order as illustrated below.

Option 1: Students who are confident at the start of the first semester that they wish to pursue the BME/EE double major and who feel well prepared for the rigors of university study should follow this plan for the first two years:

Semester 1			Semester 2		
Chem 102,104,106a	General Chemistry	4	Chem 102,104,106b	General Chemistry	4
ES 140	Intro. to Computing in Eng.	3	Math 155b	Calculus	4
Math 155a	Calculus	4	Phys 116a, 118a	General Physics	4
CS 103	Programming	3	EECE 116	Digital Logic	4
LAC	LAC Elective	3			
	Total Hours	17		Total Hours	16
Semester 3			Semester 4		
BME 101	Biomechanics	3	BME 103	Biomaterials	3
BSCI 110a,111a	Intro to Biological Science	4	BSCI xxx	2 nd BSCI course with lab	4
EECE 112	Circuits I	3	EECE 213, 213L	Circuits II	4
Math 175	Calculus	3	Math 196	Diff Eqns & Linear Algebra	4
Phys 116b, 118b	General Physics	4	LAC	LAC Elective	3
	Total Hours	17		Total Hours	18

Option 2: Students who decide during the first semester that they wish to pursue the BME/EE double major and who have little to no programming experience, especially with Matlab, should follow this plan for the first two years:

Semester 1			Semester 2		
Chem 102,104,106a	General Chemistry	4	Chem 102,104,106b	General Chemistry	4
ES 140	Intro. to Computing in Eng.	3	Math 155b	Calculus	4
LAC	LAC Elective	3	Phys 116a, 118a	General Physics	4
LAC	LAC Elective	3	CS 103	Programming	3
Math 155a	Calculus	4			
	Total Hours	17		Total Hours	15
Semester 3			Semester 4		
BME 101	Biomechanics	3	BME 103	Biomaterials	3
BSCI 110a,111a	Intro to Biological Science	4	BSCI xxx	2 nd BSCI course without lab*	3
EECE 112	Circuits I	3	EECE 116	Digital Logic	4
Math 175	Calculus	3	EECE 213, 213L	Circuits II	4
Phys 116b, 118b	General Physics	4	Math 196	Diff Eqns & Linear Algebra	4
	Total Hours	17		Total Hours	18

*Second BSCI lab must be taken in Semester 5, 6, 7, or 8.

Option 3: Students who have programming experience and who are willing to self-study Matlab as is needed for BME 101 in the third semester may follow this plan for the first two years:

Semester 1			Semester 2		
Chem 102,104,106a	General Chemistry	4	Chem 102,104,106b	General Chemistry	4
ES 140	Intro. to Computing in Eng.	3	Math 155b	Calculus	4
Math 155a	Calculus	4	Phys 116a, 118a	General Physics	4
LAC	LAC Elective	3	EECE 116	Digital Logic	4
LAC	LAC Elective	3			
	Total Hours	17		Total Hours	16

Semester 3			Semester 4		
BME 101	Biomechanics	3	BME 103	Biomaterials	3
BSCI 110a,111a	Intro to Biological Science	4	BSCI xxx	2 nd BSCI course with lab	4
EECE 112	Circuits I	3	CS 103	Programming	3
Math 175	Calculus	3	EECE 213, 213L	Circuits II	4
Phys 116b, 118b	General Physics	4	Math 196	Diff Eqns & Linear Algebra	4
	Total Hours	17		Total Hours	18

Students in each of the above options complete the following courses in Semesters 5-8, noting that Option 2 students must complete their second BSCI lab in one of these remaining semesters.

Semester 5			Semester 6		
BME 210	Physiological Transport	3	BME 252	Systems Physiology	3
BME 251	Systems Physiology	3	BME 260	Analysis of BME Data	3
EECE 233	Electromagnetics	3	BME 271	Medical Instrumentation	4
EECE 235	Electronics I	4	BSCI lab	2 nd BSCI lab if not already completed	1
LAC	LAC Elective	3	EECE 214	Signals and Systems I	3
			EECE elective ²	EECE Elective	3
	Total Hours	16		Total Hours	17

Semester 7			Semester 8		
BME 255W	BME Laboratory	3	BME 273	Design of BME Devices and Systems II	3
BME 272	Design of BME Devices and Systems I	2	EECE Elective ²	EECE Elective	3
BME 297	Sr Engr Design Seminar	1	EECE Elective ²	EECE Elective	3
EECE elective ²	EECE Elective	3	LAC	LAC Elective	3
EECE elective ²	EECE Elective	3	LAC	LAC Elective	3
BME elective ²	BME Elective	3			
LAC	LAC Elective	3			
	Total Hours	18		Total Hours	15

Hours required to graduate = 133

Notes:

1. Students with a strong desire to study C++ will be allowed to substitute a three credit hour C++ course for CS 103 as long as they hold themselves responsible for learning the Matlab skills needed in later courses. Note that CS 103 is a prerequisite for BME 101. CS 103 Programming in Matlab is strongly recommended for BME/EE double majors with the exception that students anticipating careers in computing or microcircuits may wish to choose a C++ course.
2. Three hours of BME electives offered in BME and fifteen hours of EECE electives are required for the double major. Within these 15 hours of EECE electives, students must complete at least two courses from at least two concentration areas in EE. Presently, the electrical engineering program has five concentration areas: computer engineering, microelectronics, signal/ image processing, robotics, and networking & communications. A list of approved courses in these five concentration areas may be obtained from the EECE departmental office or EECE Director of Undergraduate Studies. Also, at least one of the elective courses must be an approved design domain expertise ("DE") course.
3. Elective courses (liberal arts core, BME, and EECE) may be moved around as desired.