



**Department of Bioengineering
Undergraduate Handbook
2016/17***

University of Utah Department of Bioengineering
(Revision: Oct 12, 2016)

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* The Year of this handbook corresponds to the year of regular entry into the program, typically the academic year in which a student takes BIOEN 3301 (Computational Methods) and BIOEN 3101 - Biosignals Analysis, ideally the spring semester of the sophomore year. This will also become the “catalog year” for each student.

The Department of Bioengineering offers a Bachelor of Science degree in Biomedical Engineering, as well as a program for earning a combined BS/MS degree in Biomedical Engineering. The Department also offers MS, and PhD degrees (described at <http://www.bioen.utah.edu/education/graduate/>).

This handbook is intended to give information about policies and procedures for the undergraduate program in Biomedical Engineering but it cannot replace discussing your questions with advisors. Please come to the Department office at Sorenson Molecular Biotechnology Building Suite 3100, Office 3221, or email one of the undergraduate advisors: Heather Palmer (<mailto:Heather.J.Palmer@utah.edu>), Kelly Broadhead (<mailto:Kelly.Broadhead@utah.edu>), John Skousen (<mailto:John.Skousen@utah.edu>) or the coordinator, Page Bailey (<mailto:page.bailey@utah.edu>) to get answers to questions not answered here. The information in this handbook as well as various downloadable forms are also available online at <http://www.bioen.utah.edu>.

The University of Utah is committed to policies of equal opportunity, affirmative action, and nondiscrimination. The University seeks to provide equal access to its programs, services and activities for people with disabilities.

Each year, there are changes in the Handbook and we mark such changes from the previous edition with a vertical bar in the right margin, as with this paragraph.

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See the site for links to:			
		Course Descriptions	
		Faculty Directory	
		Undergraduate Studies	
College of Engineering Web Site: www.coe.utah.edu			
University of Utah Web Site: www.utah.edu			
Biomedical Engineering Society www.bmes.org			
Engineering in Medicine & Biology: www.embs.org			
Utah Life Science www.utahlifescience.com			

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1 Program description

1.1 Mission

The mission of the Department of Bioengineering (ABET accredited since 2010) is to advance human understanding, health, and the quality of life through:

- internationally recognized research, discovery, and invention in the area of biomedical engineering;
- education of world-class Ph.D. scientists and engineers for accomplishment in research, academics, medicine, and industry;
- education of nationally-recognized B.S. and M.S. graduates for success and leadership in industry and in preparation for future study in medicine, science and engineering;
- transfer of scientific discoveries and biomedical technology to the private sector nationwide;
- delivery of high-quality M.E. continuing education to enhance the economy by supporting biomedical industries;
- training of students throughout the College of Engineering in bio-based solutions to traditional engineering problems and in the application of their specialty to biological and biomedical science.

1.2 Educational objectives

The biomedical engineering undergraduate program is dedicated to preparing graduates for professional careers. We educate students such that our graduates will be:

- successful in graduate programs, in professional schools, including medicine and law, or in a biomedical engineering aligned career;
- able to effectively communicate and solve problems at the interface of engineering and biology appropriate to their chosen profession, as well as understand and apply standards of ethical behavior;
- motivated to pursue life-long learning, including understanding contemporary questions at the interface of science, medicine, technology, and society.

1.3 Student outcomes

The Undergraduate Engineering Program Outcomes are:

- an ability to apply knowledge of mathematics, science, and engineering;
- an ability to design and conduct experiments, as well as to analyze and interpret data;
- 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;
- an ability to function on multidisciplinary teams;
- an ability to identify, formulate, and solve engineering problems;
- an understanding of professional and ethical responsibility;

- an ability to communicate effectively;
- 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.

The BME Specific Program Outcomes include:

- Applying principles of engineering, biology, human physiology, chemistry, calculus-based physics, mathematics (through differential equations) and statistics ;
- Solving biomedical engineering problems, including those associated with the interaction between living and non-living systems;
- Analyzing, modeling, designing, and realizing biomedical engineering devices, systems, components, or processes; and
- Making measurements on and interpreting data from living systems.

2 Status and admissions

2.1 Pre-Major status

From 2016, all students wishing to study engineering are admitted to the College of Engineering and hence have formal status at the University. However, such admission does not mean that the student has also received admission to major status in any program within the College. To receive a degree in Biomedical Engineering (BME) requires admission to the BME program and for this, there is a well defined process that all students must pursue.

Students beginning their undergraduate studies who have not been admitted to the BME program as freshmen, including transfer students, should choose the Pre-Biomedical Engineering category as their major for registration purposes. All students are eligible to register for BIOEN 1010. Pre-major students may enroll for BIOEN 1020 and 2100 if they have met the prerequisites. Junior- and senior-year courses in the Biomedical Engineering program are usually open only to students with major status. Pre-majors may also apply for admission to upper division classes by special permission of the instructor and the department. Pre-majors are strongly encouraged to meet early with one of the pre-major advisors in the Department to outline a course of study that will prepare them to apply for major status in a timely manner.

2.2 Admission to major status

2.2.1 Freshmen admission

A very small number of highly qualified students are admitted directly to major status in the program as freshmen. Such admission is based on academic excellence and results from a careful screening of students' records upon their application for admission to the University. No direct action is required from students wishing to be considered for freshman admission. Students who are admitted as freshman **must maintain the same academic standard as required for students pursuing the standard admission to major status described below.**

2.2.2 Standard admission

Admission to major status in the Biomedical Engineering program is limited by the availability of Department teaching and laboratory resources and based solely on academic achievement. Admission to major status is based on a **specific grade point average made up of selected courses**. See Application Form at the end of this document and check with the Undergraduate Advisory in the Department office for details. In order to register for Department upper-division courses (3000-level or higher), a student **must have major status** (or receive permission from the Department and course instructor for exceptional circumstances).

To be considered for admission to major status, a student must have completed the following courses:

BIOEN 1010	Careers in Biomedical Engineering
BIOEN 1020	Fundamentals of Bioengineering I
BIOEN 2100	Fundamentals of Bioengineering II
BIOL 2020	Cell Biology (or equivalent)
CHEM 1220	General Chemistry II
CHEM 1225	General Chemistry II Lab
MATH 1321 or 2210	Accel. Eng. Calc II or Calculus III
MATH 2250	Diff Eq/Lin Alg
PHYS 2210	Physics for Scientists and Engineers I
PHYS 2220	Physics for Scientists and Engineers II
Note:	Physics labs are no longer required

with an grade point average (GPA) in these required classes of 3.0 or better. A student must also have an overall University GPA of at least 3.0 (not including transfer credit, unless the required courses are from a transfer institution, in which case those grades will be counted among the required course GPA). Students with a required-class GPA below 3.35 but above 3.0 will join an admission waiting list. Final decisions on applications in the waiting list will occur just before the spring semester of each year.

Note that students may substitute a “C” grade for any class not yet taken and be considered for admission as long as their required-course GPA, as described above, meets the requirements for admission and the cumulative University GPA and the required-course GPA are both at least 3.0.

Conditional and Contingent Admission status There are several forms of admission into the BME program:

1. Conditional admission: Students who have completed most of the required courses in Section 2.2.2 but can meet admission requirements by substituting a “C” grade for any incomplete courses, may also apply to the program. They will be admitted under the condition that they subsequently complete the missing courses with a “C” grade or better.
2. Contingent admissions: Students whose prerequisite course grades do not meet the acceptance threshold may be accepted on contingent basis with strict performance requirements for the first semester of the program and meet the following conditions:
 - Students must achieve a composite GPA of 3.35 or better in their technical courses taken in the first spring and summer semesters of their admission to the program.
 - Students must complete all the unfulfilled prerequisite courses with a “C” grade or better.
 - Students must complete the Organic Chemistry I + Lab in the first spring or summer semesters of their admission with a “C” grade or better. These grades will also be part of the composite GPA used for admission evaluation.

Admission timing: The minimum duration of the BME major program is 5 semesters, starting in the spring semester of the entry year into the major. Thus, students are strongly encouraged to seek admission to the major in time for the **Spring semester of their sophomore year** in order to best meet the prerequisite requirements and complete the program on time. A delay in admission application after this deadline may present significant disadvantages to the student leading to prolonging the program beyond 5 semester and causing delays in graduation.

Catalog Year The Catalog Year is critical for students as it determines the courses that are required for graduation. The setting of catalog year is based on the academic year in which students enter the major and take BIOEN 3301 (Computational Methods), usually their first upper division course (3000 level or above, **excluding BIOEN 3091**) in the program. Note that students admitted in the freshman year should use the same criteria for determining their catalog year.

Students may opt to change their catalog year to a later date in order to adjust to advantageous changes in the requirements of the program. Such a change in catalog year **MUST** occur under advisement of a program advisor and must be documented in the student's file. The last time to adjust catalog year occurs as part of the application for graduation.

2.3 Transfer Credit and Exceptions to Policy

Students wishing to apply credit from another school for any technical class which is not included in the College of Engineering Articulation Agreement (available on the University of Utah web site and in the Department of Bioengineering Office) must submit a Petition for Transfer Credit or Variance (the "tan sheet") along with thorough supporting documentation. Only after the petition has been approved by the Department will transfer of technical credit be allowed toward completion of the BS degree in Biomedical Engineering. This requirement applies even to classes that have been accepted by the University for general transfer credit; the classes must still be submitted for Departmental acceptance for transfer credit toward the degree by petition (unless they appear on the Articulation Agreement, in which case approval is automatic). Note that any exception to the Department's academic policies must be requested by submission of this same form, and that such an exception is allowed only after the petition has been approved by the Department.

2.4 Scholarships

The Department, in cooperation with the College of Engineering, provides a limited number of scholarships to highly qualified applicants. Applications for scholarships are usually due on February 15 of each year. Contact the Department Office or see the Department web site for details.

3 Requirements for the B.S. Degree in BME

The undergraduate degree (B.S.) in Biomedical Engineering is granted upon successful completion of a minimum of 127 semester hours of the following requirements:

1. University's General Education requirements,
2. Mathematics and Science courses,
3. Biomedical Engineering core courses, and
4. BME Electives.

These program requirements are described in detail below. Note that some of the requirements have changed from previous years and may continue to change.

Some of the General Education, mathematics, and science courses may be waived for students who have AP credit from high school in those subjects and who have achieved certain grades on the AP test. Details

are in the <http://www.ugs.utah.edu/catalog/coursedescriptions.html#letterp> under the department offering the specific course.

3.1 General education requirements

General Education Requirements:

In order to graduate, all University of Utah undergraduate students must complete a series of general education courses. AP Test scores, concurrent courses, transfer credit, or credit from a previous degree may be used to satisfy some or all of the course requirements. Specific honors and LEAP courses can be used to satisfy general education requirements. Some Diversity (DV) and International Requirement (IR) courses will also satisfy a FF, BF, or HF course. The total number of courses needed will depend on students' previous work and if they choose to take a DV or IR course that counts towards a FF, BF, or HF requirement*. **Due to the heavy load of classes needed to prepare Bioengineering students for upper division course work, most students take general education courses later in their careers at the U, during summer, or during fall/spring breaks.**

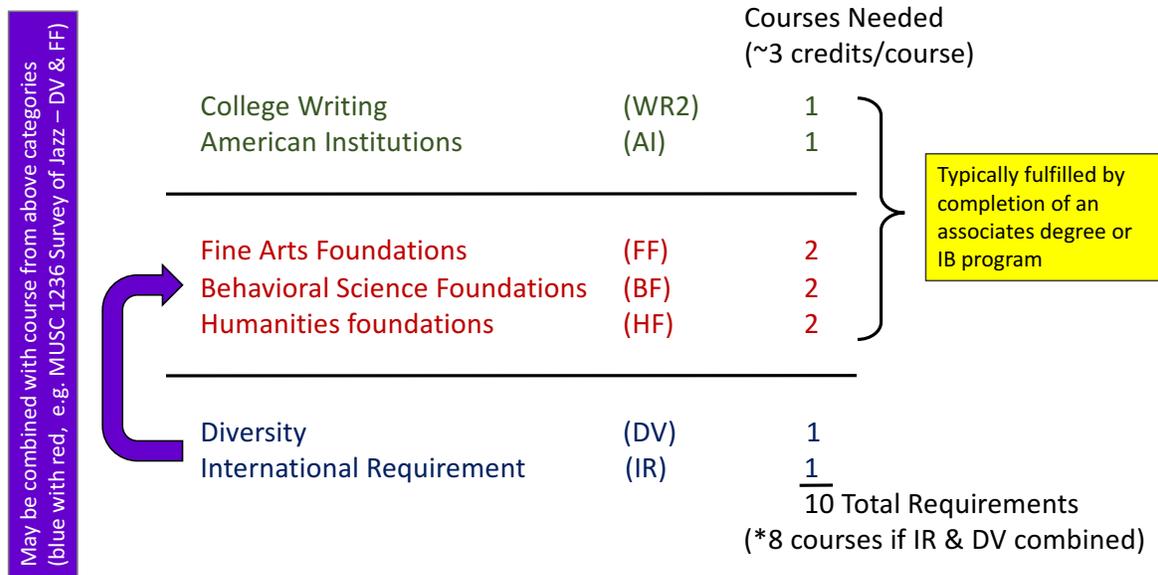


Figure 1: Gen Ed Requirements. Flowchart of the general education requirements for admission to the BME program.

See the website <http://ugs.utah.edu/gen-ed-reqs/index.php> for a description of the University's General Education requirements and See Figure 1 for a summary. General Education includes Intellectual Explorations courses (including a Diversity requirement), and the Writing, American Institutions, and Quantitative Reasoning course requirements.

Intellectual explorations Students must take two courses in each of the areas of Fine Arts, Humanities, and Social and Behavioral Science. The requirement in the Physical and Life Science area is automatically met by the Biomedical Engineering curriculum. One of the Intellectual Explorations courses selected should also meet the Diversity requirement. See the website www.ugs.utah.edu/?pageId=2427 for a description and list of Diversity courses. Note that not all of the classes that meet the Diversity criterion are also courses in the Intellectual Explorations lists. Students should try to take a Diversity course that will clear two requirements (Diversity and Intellectual Explorations) simultaneously.

Lower division writing Writing 2010 or the equivalent is required.

Upper division communications/writing The University's upper-division communication/writing requirement will automatically be met by successful completion of BIOEN 4202 (Thesis Writing and Communication II) in the senior year.

American institutions See the website www.ugs.utah.edu/?pageId=2404 for courses that meet the American Institutions requirement. The American Institutions requirement may also be cleared by AP credit or by

examination at the Testing Center in the Student Services Building during regular testing room hours.

Quantitative reasoning The Quantitative Reasoning and Quantitative Intensive course requirements (QA, QB, and QI) are met by the Biomedical Engineering curriculum through the calculus requirements and through BIOEN 4001 and BIOEN 4250 (Biotransport/Biomolecular and Biomechanics).

International Course Requirement Each student entering the University on or after Fall, 2007, must fulfill an upper division Internal Course Requirement. This requirement will give students a broad base of knowledge about global issues and about global perspectives in a comparative context. It will introduce students to international frames of reference so that they may think critically about long-standing and newly emerging issues. It will help students accept and appreciate the interdependence of nations and the viewpoints of other nations, and give them the ability to communicate with people across international borders.

At present, the College of Engineering does not offer an accredited class for this requirement. Please see the web site www.ugs.utah.edu/?pageId=2431 for more information and an up to date list of accepted courses.

3.2 Mathematics Courses

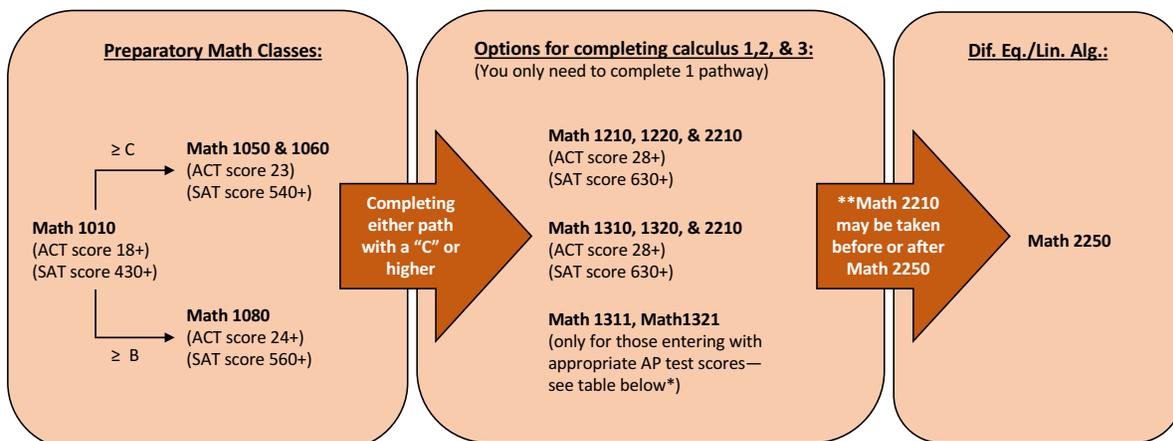
The following courses (or their equivalent) are required from the areas of mathematics:

MATH 1310	Eng Calc I
MATH 1320	Eng Calc II
MATH 2210	Calc III
or (recommended)	
MATH 1311	Honor's Accelerated Eng Calc I
MATH 1321	Honor's Accelerated Eng Calc II
MATH 2250	Diff Eq/Lin Alg

All mathematics, science, and bioengineering core and technical elective courses should be taken for letter grade whenever this option is available.

Math:

All bioengineering students must master the concepts in at least calculus 1, 2, & 3 as well as differential equations/linear algebra. There are 3 options for completing the calculus series. Selecting the correct path will depend on your previous college courses and/or test scores. Furthermore, depending on your previous courses/test scores, additional classes may be required in order to be prepared for entry into one of the University of Utah's calculus series.



Note: If any student does not believe their ACT/SAT test scores accurately represent their math skills, students may take the Accuplacer Exam for placement purposes. Accuplacer exams are administered by appointment in the Testing Center (SSB 498) at the Student Services Building (and most other colleges/universities). Week long preparatory boot camps are held to prepare students for the Accuplacer exam over the summer.

AP Calc Exam & Score	Courses you may start in
BC of 4 or 5	Math 1321 or 2210
BC of 3	Math 1311, 1320, or 1220
AB of 4 or 5	Math 1311
AB of 3	Math 1310 or 1210

**Math 2210 may be take after Math 2250 *if* Phys 2210 and Math 1220 or 1320 are also completed before taking Math 2250.

Figure 2: Math class requirements. Flowchart of the math course requirements for admission to the BME program.

3.3 Science Courses

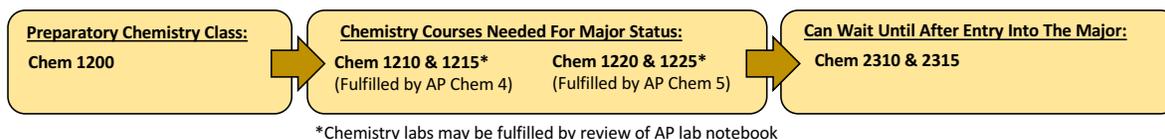
The following courses (or their equivalent) are required from the areas of science:

PHYS 2210	Physics for Scientists and Engineers I
PHYS 2220	Physics for Scientists and Engineers II
CHEM 1210	General Chemistry I
CHEM 1215	General Chemistry Lab I
CHEM 1220	General Chemistry II
CHEM 1225	General Chemistry Lab II
CHEM 2310	Organic Chemistry I
CHEM 2315	Organic Chem Lab I
BIOL 2020	Cell Biology

All mathematics, science, and bioengineering core and technical elective courses should be taken for letter grade whenever this option is available.

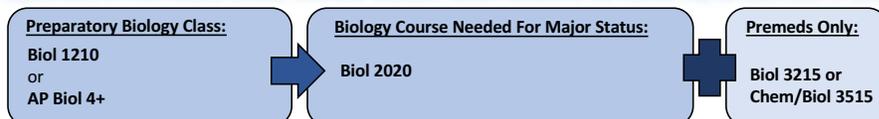
Chemistry:

All bioengineering students must master the concepts in at least General Chemistry 1 & 2 as well as Organic Chemistry 1 (with the accompanying labs for each course). If a student does not have previous Chemistry experience, we recommend taking a preparatory Chemistry course (1200) prior to taking General Chemistry 1 (Chem 1210). AP testing can be used to count for one or both of the General Chemistry courses. However, students who plan on going to Medical School may still need to take both General Chemistry courses as most Medical Schools require at least 4 semesters of College Chemistry with labs and typically do not recognize AP Scores in this subject. If AP students also completed a laboratory component at their high school, they may petition the Chemistry department to waive one or both of the General Chemistry lab requirements by submitting their lab notebooks to the appropriate instructor (currently Dr. Atwood). Wherever available, honors versions of the courses may be substituted to satisfy the requirements.



Biology:

All bioengineering students must complete Cell Biology. In order to take Cell Biology, the biology department requires either an AP Biology Score of 4+ or General Biology (Biol 1210). Typically, the best time to take General Biology is Fall or Summer semester as the Spring semester is typically quite heavy on credits. For students planning to go to Medical School, please note that you should also take the Cell Biology lab (or an alternate biology lab) to fulfill the entry requirements of most medical schools. Wherever available, honors versions of the courses may be substituted to satisfy the requirements.



Physics:

All bioengineering students must complete Physics for Scientists and Engineers 1 & 2 (Calculus-based physics). If you have never had a physics course in high school or college, we recommend taking a preparatory algebra-based physics course (Phys 1500). For students planning to go to Medical School, please note that you should also take two physics labs to fulfill the entry requirements of most medical schools. Either the algebra or calculus based physics labs will count. Wherever available, honors versions of the courses may be substituted to satisfy the requirements.

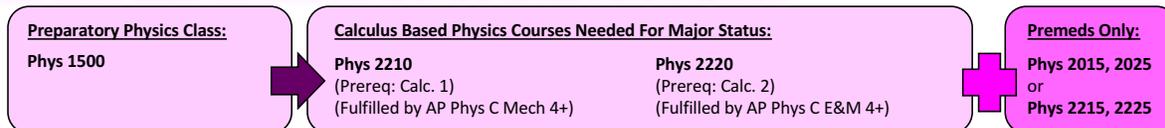


Figure 3: Chemistry, Biology and Physics class requirements. Flowchart of the science course requirements for admission to the BME program.

3.4 Biomedical Engineering Core

The following 16 courses are required from the BME Core:

Pre-major

BIOEN 1010	Careers in Biomedical Engineering
BIOEN 1020	Fundamentals of Bioengineering I
BIOEN 2100	Fundamentals of Bioengineering II

Major

BIOEN 3070	Bioengineering Statistics*
BIOEN 3091	Current Research in Bioengineering
BIOEN 3101	Biosignal Analysis
BIOEN 3202	Physiology for Engineers
BIOEN 3301	Computational Methods for Bioengineers
BIOEN 3801	Biomedical Engineering Design I
BIOEN 4801	Biomedical Engineering Design II
BIOEN 4200	Biomedical Research or BIOEN 4990 Internship
BIOEN 4201	Thesis Writing and Communication I
BIOEN 4202	Thesis Writing and Communication II
BIOEN 4001	Biotransport and Biomolecular Engineering
BIOEN 4101	Biosystems Analysis and Modeling
BIOEN 4250	Introduction to Biomechanics
BIOEN 4301	Intro to Modern Biomaterials

* It is possible to substitute another statistics class from the College of engineering *e.g.*, MET E 3070, ECE 3530, or CS 3130 for this requirement. We will not accept the Math 3070 course as a substitute.

3.5 BME Electives

BME electives are courses that students use to help achieve the main goal of the program—to determine (or confirm) the future direction of their post graduate career and to ensure they are optimally prepared for that career. For some students, BME elective classes offer the opportunity to deepen and focus their knowledge in order to prepare for a career in a specific area of biomedical engineering. Others take electives to help make the decision among the wide range of directions open to students in biomedical engineering, in anticipation of subsequent education and training in the selected area(s).

The Biomedical Engineering program is loosely organized into the following tracks or areas of emphasis. Note that students make take classes from any number of tracks so that the **selection of a track direction is not restrictive**: but, rather, the set of BME electives can include topics from more than one of the tracks described above.

Bioelectrical Engineering: based on course material from electrical engineering typically with a focus on instrumentation, device development, or electrically based diagnostics and therapy.

Biomaterials Engineering: based on course material from materials science, material engineering, and mechanical engineering focused on the role of materials in biomedical applications. Also includes topics like biocompatibility, tissue engineering, biomimetic materials, and synthetic biology.

Biomechanical Engineering: based on course material from physics or mechanical engineering focused on mechanical aspects of the body, mechanical characteristics of biomedical materials, fluids, use of heat and heat-inducing therapies, and prosthetics.

Biomedical Imaging: based on courses in mathematics, radiology, and bioengineering that cover the underlying physics and mathematics of all forms of medical imaging as well as the use of image processing to extract information from those images.

Computational Bioengineering: based on courses in computer science, physics, and mathematics and focused on the application of numerical and computational approaches to all aspects of the analysis, interpretation, visualization, and simulation of living systems.

Premedical Preparation: includes the required courses for entry to most medical and dental programs with an emphasis on clinical perspectives of engineering.

A student must propose a set of BME elective classes based on his/her career goals and often after a discussion with an undergraduate advisor in order to meet one or more of the following needs:

- Deeper knowledge of a particular technical field because of a pre-existing interest or focused career goals.
- Broader knowledge of a technical field in order to be prepared for a diverse career based on post graduate training.
- Exploration of a wide variety of technical directions and courses in order to identify the most compelling and fulfilling future career directions.

Section 5 contains specific requirements and lists of approved BME electives . Note that approval of the track electives **must occur in discussion with the Major Advisory**.

3.6 COOP/Internship Opportunities

Students interested in including industrial experience in their university education should consider participating in the Department's COOP/Internship Program. Internships can also lead to credit through the required BIOEN 4200 Research Class, which must be taken once as a core class and a second time for 1 hour of track credit. Please see the Undergraduate Coordinator for details.

3.7 Continuing Performance

A student admitted to major status must maintain a cumulative University of Utah GPA, as reported on his or her transcript, at or above 3.00. **Students must also have a minimum of a 3.0 cumulative GPA to graduate.**

Each course taken to satisfy departmental requirements in mathematics, chemistry, physics, biology, biomedical engineering core, and the BME electives must be taken for credit and passed with a grade of C or better. **Generally, a student may repeat these technical courses only once, and the second grade received will be counted for the requirement.** It is possible to apply for a variance from these requirements by meeting with the Program Advisor.

3.8 Leave of Absence

Students are expected to complete all degree requirements within four years of acceptance to major status (6 years for students admitted as freshmen) . Students accepted into major status who are planning to be absent from the program for more than one year should request a leave of absence by submitting a letter to the Undergraduate Advisor. (A copy should also be sent to the University Admissions Office to avoid the necessity of reapplying for admission and repaying the admission fee upon return.)

Students who move to a part time status and do not take the normal course load should apply to the Major Advisor, fill out a variance (tan colored form), and work out an acceptable plan for continuing progress in the program.

Otherwise, students accepted into major status who are not making satisfactory progress may be dropped from the program and declared inactive. To be reinstated to active status, students must submit a written petition to the Director of Undergraduate Studies. Reinstated students matriculate under the graduation requirements in place at the time they are reinstated.

3.9 Probation

A student admitted to major status whose cumulative GPA falls below 3.00 is placed on departmental academic probation and given written instructions for a return to good standing. Normally, these conditions must be met during the ensuing semester. Students who fail to meet probationary conditions are dropped from the program. Reinstatement requires a written petition to the Director of Undergraduate Studies. Reinstated students matriculate under the graduation requirements in place at the time they are reinstated.

3.10 Repeat and Withdrawal Policies

The Biomedical Engineering program adheres to the College of Engineering policies for a course that is repeated and for withdrawals. In particular, a technical course required for the degree may be repeated only once, and the second grade received will be counted toward application for admission to major status and to the continuing performance requirement. Grades of W, I or V on the student's record count as having taken the class. This policy does not apply to courses taken to satisfy Intellectual Exploration and lower division Writing requirements.

3.11 Academic Misconduct

The Biomedical Engineering program has a zero tolerance policy with any form of academic misconduct. We encourage group interactions and exchange but ultimately, each student must submit individual homework assignments, projects, and exams (with the exception of Design Class projects or those assignments explicitly declared otherwise). We follow the University policy on academic misconduct, as follows:

Definitions

“Academic misconduct” includes, but is not limited to, cheating, misrepresenting one’s work, inappropriately collaborating, plagiarism, and fabrication or falsification of information, as defined further below. It also includes facilitating academic misconduct by intentionally helping or attempting to help another to commit an act of academic misconduct.

- 1. “Cheating” involves the unauthorized possession or use of information, materials, notes, study aids, or other devices in any academic exercise, or the unauthorized communication with another person during such an exercise. Common examples of cheating include, but are not limited to, copying from another student’s examination, submitting work for an in-class exam that has been prepared in advance, violating rules governing the administration of exams, having another person take an exam, altering one’s work after the work has been returned and before resubmitting it, or violating any rules relating to academic conduct of a course or program.*
- 2. Misrepresenting one’s work includes, but is not limited to, representing material prepared by another as one’s own work, or submitting the same work in more than one course without prior permission of both faculty members.*
- 3. “Plagiarism” means the intentional unacknowledged use or incorporation of any other person’s work in, or as a basis for, one’s own work offered for academic consideration or*

credit or for public presentation. Plagiarism includes, but is not limited to, representing as one's own, without attribution, any other individuals words, phrasing, ideas, sequence of ideas, information or any other mode or content of expression.

- 4. "Fabrication" or "falsification" includes reporting experiments or measurements or statistical analyses never performed; manipulating or altering data or other manifestations of research to achieve a desired result; falsifying or misrepresenting background information, credentials or other academically relevant information; or selective reporting, including the deliberate suppression of conflicting or unwanted data. It does not include honest error or honest differences in interpretations or judgments of data and/or results.*

Sanctions:

A student who engages in academic misconduct as defined above may be subject to academic sanctions including but not limited to a grade reduction, failing grade, probation, suspension or dismissal from the program or the University, or revocation of the students degree or certificate. Sanctions may also include community service, a written reprimand, and/or a written statement of misconduct that can be put into an appropriate record maintained for purposes of the profession or discipline for which the student is preparing.

- 1. Any person who observes or discovers academic misconduct by a student should file a written complaint with the faculty member responsible for the pertinent academic activity within thirty (30) business days of the date of discovery of the alleged violation.*
- 2. A faculty member who discovers or receives a complaint of misconduct relating to an academic activity for which the faculty member is responsible shall take action under this code and impose an appropriate sanction for the misconduct.*
- 3. Upon receipt of a complaint or discovery of academic misconduct, the faculty member shall make reasonable efforts to discuss the alleged academic misconduct with the accused student no later than twenty (20) business days after receipt of the complaint, and give the student an opportunity to respond. Within ten (10) business days thereafter, the faculty member shall give the student written notice of the academic sanction, if any, to be taken and the student's right to appeal the academic sanction to the Academic Appeals Committee for the college offering the course. Such sanctions may include requiring the student to rewrite a paper(s) or retake an exam(s), a grade reduction, a failing grade for the exercise, or a failing grade for the course. In no event shall the academic sanction imposed by the faculty member be more severe than a failing grade for the course.*
- 4. If the faculty member imposes the sanction of a failing grade for the course, the faculty member shall, within ten (10) business days of imposing the sanction, notify in writing, the chair of the students home department and the senior vice president for academic affairs or senior vice president for health sciences, as appropriate, of the academic misconduct and the circumstances which the faculty member believes support the imposition of a failing grade. If the sanction imposed by the faculty member is less than a failing grade for the course, the faculty member should report the misconduct to the dean or chair of the students home department or college. Each college shall develop a policy specifying the dean and/or the chair as the appropriate person to receive notice of sanctions less than a failing grade for the course.*
- 5. A student who believes that the academic sanction given by the faculty member is arbitrary or capricious should discuss the academic sanction with the faculty member and attempt to resolve the disagreement. If the student and faculty member are unable to resolve the disagreement, the student may appeal the academic sanction to the Academic Appeals Committee for the college offering the course within fifteen (15) business days of receiving written notice of the academic sanction.*

6. *If the faculty member, chair or vice president believes that the student's academic misconduct warrants an academic sanction of probation, suspension or dismissal from a program, suspension or dismissal from the University, or revocation of a student's degree or certificate, he/she may, within thirty (30) business days of receiving notice of the misconduct, prepare a complaint with recommendations, refer the matter to the chair or deans designee of the student's home department or college, and notify the student of the complaint and recommendation. The chair and/or deans designee of the home department/college may undertake an investigation of the allegations and recommendations set forth in the complaint. Within ten (10) business days of receipt of the complaint, the chair and/or deans designee shall forward the complaint and recommendation to the Academic Appeals Committee of the home college for proceedings in accordance with Section C, below, and so notify the student in writing. The chair and/or dean may accompany the complaint with his/her own recommendation supporting or opposing the sanction sought in the complaint. The person initiating the original complaint continues as the complainant in the case unless that person and the chair/dean's designee both agree that the latter shall become the complainant. If the student has appealed the academic sanction imposed by the faculty member, the time periods set forth in this paragraph may be extended until ten (10) business days after the resolution of the student's appeal.*
7. *If a department chair, the dean, the senior vice president for academic affairs and/or the senior vice president for health sciences, become aware of multiple acts of academic misconduct by a student, they or their designees may, within thirty (30) business days after receiving notice of the last act of misconduct, prepare a complaint with recommendations for probation, suspension or dismissal from a program, suspension or dismissal from the University, or revocation of a degree or certificate, and refer the matter to the Academic Appeals Committee of the student's home college for proceedings in accordance with Section C, below, and so notify the student in writing.*

3.12 Preparation for Graduation and Exit Interviews

In order to be cleared to graduate, a student **must meet with the Major Advisor** to review the DARS audit report and to verify that all graduation requirements will be completed by the time of graduation. This must be done **one semester prior to graduation**. See www.sa.utah.edu/regist/graduation/applying.htm for the details, deadlines, and links to graduate forms.

Immediately prior to graduation, the student attends an exit interview with a faculty member during a time announced in the senior classes. This exit interview **is required** and provides important feedback to the Department to help improve the Biomedical Engineering program.

3.13 Undergraduate Advising

To receive specific advising, please visit the Department of Bioengineering undergraduate office, SMBB Suite 3100, Office 3221, or contact any of the following advisors:

- Heather Palmer (mailto:Heather.J.Palmer@utah.edu@utah.edu),
- Kelly Broadhead (mailto:Kelly.Broadhead@utah.edu),
- John Skousen (mailto:John.Skousen@utah.edu)

4 Sample Biomedical Engineering Plan of Study

Here is a sample plan of study, a plan few students follow exactly but a useful starting point for planning. The best order of classes will depend on the needs of the student and the Undergraduate Advising can assist in selection of courses. **Note:** many students use the summer semesters for courses in the Sciences and Math and for the Gen Ed requirements. Descriptions of Bioengineering Department courses can be found at www.bioen.utah.edu/education/syllabi.php?log=out

Fall Semester			Spring Semester		
Course #	Title	Hrs	Course #	Title	Hrs
Freshman Year					
BIOEN 1010	Careers in Biomed Eng	1	BIOEN 1020	Funds of Bioeng I	3
CHEM 1210	General Chemistry I	4	CHEM 1220	General Chemistry II	4
CHEM 1215	General Chemistry Lab I	1	CHEM 1225	General Chemistry Lab II	1
MATH 1311	Hon Accel Eng Calc I ⁽¹⁾	4	MATH 1321	Hon Accel Eng Calc II ⁽¹⁾	4
WRTG 2010	College Writing	3	PHYS 2210	Physics for Scientists I	4
	Gen Ed Elective 1	3			
Total		16			16

Sophomore Year (Spring Entry in Program)					
BIOEN 2100	Funds of Bioeng II	4	BIOEN 3301	Computational Methods	3
BIOL 2020 ⁽²⁾	Cell Biology	3	BIOEN 3091	Current Research in BME	1
MATH 2250	Diff Eq/Lin Alg	4	BIOEN 3101	Biosignals Analysis	3
PHYS 2220	Physics for Sci. & Eng II	4	CHEM 2310	Organic Chemistry I	4
			CHEM 2315	Org. Chem I Lab	2
				Gen Ed Elective 2	3
Total		15			16

Junior Year					
BIOEN 3202	Physiology for Engineers	4	BIOEN 3801	bioDesign I	3
BIOEN 4101	Biosystems Anal./Model.	4	BIOEN 4301	Biomaterials	4
BIOEN 3070	Statistics for Eng ⁽³⁾	3	BIOEN 4200 ⁽⁴⁾	Bioengineering Research	1
	BME Elective 1	3		BME Elective 2	3
	Gen Ed Elective 3	3		Gen Ed Elective 4	3
				Amer. Institut. Elective	3
Total		17			17

Senior Year					
BIOEN 4801	bioDesign II	3	BIOEN 4001	Biotransport/Biomolecular	4
BIOEN 4201	Writing & Communication I	2	BIOEN 4202	Writing & Communication II	2
BIOEN 4250	Biomechanics	4		BME Elective 5	3
	BME Elective 3	3		Gen Ed Elective 5	3
	BME Elective 4	3		Gen Ed Elective 6	3
Total		15			15
Grand total					127

4.1 Additional Notes

⁽¹⁾ As an alternative to this math sequence, students may take MATH 1310, 1320 and 2210.

⁽²⁾ Students who have not had AP Biology in high school (with a score of 4 or 5) must take BIOL 1210 as

a prerequisite to BIOL 2020.

- (3) MET E 3070, ECE 3530, or CS 3130 may also stand as replacement courses for BIOEN 3070. The Math 3070 will not be considered a substitute.
- (4) All students must take BIOEN 4200 at least once before they begin the Writing & Communication series (BIOEN 4201/2). Students may also repeat BIOEN 4200 up to once and apply that credit to the required BME electives. Students who perform a research internship outside of the University of Utah or with a faculty mentor who is not a member of the Department of Bioengineering must seek prior approval for BIOEN 4200 and, upon completion, a grade from the Major Advisor.

4.2 Prerequisites

While there are many variations on the plan laid out above, there are some courses which must be taken in certain orders. Such sequences are aimed at ensuring suitable preparation for all students and more productive and fulfilling experiences in the intermediate and advanced classes.

The current set of prerequisites and class sequences among the BME core classes are as follows:

1. BIOEN 1020 Fundamentals I: requires Math 1310 or 1311, and Chem 1210 and 1215. Chem 1220 and 1225 must also be taken before or concurrently.
2. BIOEN 2100 Fundamentals II: requires Math 1320 or 1321 and Physics 2210 is co-requisite.
3. BIOEN 3301 Computational Methods: should be one of the first classes students take in the program and is a prerequisite or co-requisite for almost all other BIOEN classes at the sophomore, junior, or senior levels, *i.e.*, BIOEN 3070, 3101, 3202, 4101, 4301, 4250, and 4001.
4. BIOEN 3101 Biosignals Analysis should also be taken as early as possible and is a prerequisite for BIOEN 3202 and 5101.
5. BIOEN 3070 Statistics for Engineers should be taken in the first fall semester of the major. It is a prerequisite or co-requisite for almost all other BIOEN classes at the junior or senior levels, *e.g.*, a co-requisite for BIOEN 3202, 4101, and 4250 and a prerequisite for BIOEN 3801 and 4001. For transfer students or other, exceptional situations, it is possible to take BIOEN 4301 before BIOEN 3070.
6. PHYCS 2220 Physics for Scientists II is a prerequisite for BIOEN 3202, 4101, and 4001.
7. BIOEN 3801 bioDesign I is a prerequisite for BIOEN 4801 bioDesign II.
8. BIOEN 4200 BME Research is a prerequisite for BIOEN 4201 Writing & Communication I.
9. BIOEN 4201 Thesis Writing & Communication I is a prerequisite for BIOEN 4202 Thesis Writing & Communication II.

5 BME Electives

To successfully complete the track course component of the program requires a selection of courses that meets the following goals:

1. a minimum of **15** credit hours of course work, of which
2. at least **5** hours must be from courses taught in the College of Engineering and/or the College of Mines & Earth Sciences* (ensures meeting ABET course requirements), and
3. at least 9 of the hours must be at the upper division level (3000 or above).
4. and of which up to **3** may come from upper division courses outside the colleges of Science and Engineering, provided they are approved by the Major Advisor **before they are taken**. The goal of such classes is to provide exposure to materials from other disciplines, *e.g.*, Business, Law, Ethics, that directly support the individual goals of each student. All such courses must have a significant and direct link to engineering and must deepen the skill set and exposure of students in a field related to Biomedical Engineering.

The following are useful guidelines when selecting BME Electives:

- **Note:** Transfer credits are generally only accepted as a BME elective if they are lower division (1000 and 2000 level) and must first be approved for transfer by means of a Petition for Transfer Credit or Variance (the “tan sheet”). Additionally, if transfer upper-division BME electives are accepted, they will count as lower-division credit. See Section 2.3 for more details on transfer classes.
- Use past schedules as guidelines in scheduling BME elective classes to ensure that they do not conflict with required classes.
- For admission to graduate level classes (5000, 6000), all students must simply meet standard prerequisites and obtain written (email) permission from the course instructor in order to apply for admission. With such permission in hand, contact the Undergraduate Advisor/Coordinator with proof of permission, UNID, and the specific course designation. Note that admission to 7000 classes is generally restricted to PhD students so only available to undergraduates in unusual circumstances.
- A list of Bioengineering Department courses suitable for inclusion as a BME elective appears at the end of this section.
- Pay attention to prerequisites to be sure the courses are taken in the correct order.
- Note that entry into upper division courses in other departments is often possible without the standard prerequisites for those departments as long as the associated BME core course is completed. For example, to enter upper division classes in Mechanical Engineering, ensure that the BIOEN 4250, Biomechanics, is completed first (or concurrently). When in doubt, contact the Program Director for clarification or assistance.
- Organic Chemistry II, both the lecture and lab courses, (CHEM 2320 and CHEM 2325), typically required for entry to medical school, are acceptable as BME elective.
- BIOEN 4200 UG Research must be taken once by all students who use data from an internship for their Thesis Writing and Communications series (BIOEN 4201/4202). If students perform a second semester of internship with a company, they may take the class a second time for a maximum of 1 hour of BME elective credit, even when the course contributes additional hours to the program of study.

- Directed reading, independent study, literature surveys, and special project classes do **not** generally qualify as BME electives. Exceptions are possible but the Program Director must approve these **beforehand**.
- Some seminar classes (*e.g.*, BIOEN 6464) may be acceptable for 1 hour of BME elective credit, but only when they are used only to ensure adequate **college** credit hours, *i.e.*, they are not counted as part of the minimum 15 hours.

5.1 Approval of BME Electives

A student's BME elective plan must be approved by the Department's Major Advisor by submitting a BME elective Coursework Plan via the BME Undergraduate web site (<http://ugforms.bioen.utah.edu/>) Seeking approval for a BME elective plan should occur in the first semester after admission to major status and before starting the track sequence. Students may (and almost always do) update their plans through the course of their studies and should review the plan each semester. A final version of the plan must be approved in order to complete graduation requirements. **Students who have not applied for track approval by the middle of the semester immediately following their admission may not be allowed to register for the following semester Biomedical engineering courses.**

Below are some samples of course selections organized by track or emphasis area. Note that in many cases, Bioengineering students can progress directly to the upper division classes offered by other departments **without completing the usual requirements** for those classes. When in doubt, the Major Advisor or the instructor of the course can provide guidance.

5.2 Waiting Lists

Some potential BME electives have restricted numbers so that early registration is essential. Some are traditionally so heavily subscribed that there are waiting lists set up as much as two years ahead of the course offering. To avoid disappointments and limited class availability, please see the academic coordinator.

5.3 Bioelectrical Engineering Track

BIOEN 4640	Image Processing Basics
BIOEN 5460	Engineering Aspects of Clinical Medicine
BIOEN 5480	Ultrasound
BIOEN 5602	Intro to BioImaging
BIOEN 6005	Computational Neuroscience
BIOEN 6401	Medical Imaging Systems
BIOEN 6421	Fundamentals of Micromachining Processes
BIOEN 6433	Biological Statistical Signal Processing
BIOEN 6440	Neural Engineering
BIOEN 6500	Mathematics of Imaging
BIOEN 6640	Introduction to Image Processing
ECE 2240	Fundamentals of Electric Circuits
ECE 2280	Fundamentals of Engineering Electronics
ECE 3110	Engineering Electronics II
ECE 3300	Fundamentals of Electromagnetics and Transmission Lines
ECE 3500	Fundamentals of Signals and Systems
ECE 3510	Introduction to Feedback Systems
ECE 5325	Wireless Communication Systems
ECE 5340	Numerical Techniques in Electromagnetics
ECE 5410	Lasers and Their Applications
ECE 5530	Digital Signal Processing
PHYS 3730	Intro To Computing In Physics
ENG 5020/6020	Emerging Technologies and Entrepreneurship

5.4 Biomedical Imaging Track

BIOEN 4640	Image Processing Basics
BIOEN 5480	Ultrasound
BIOEN 5601	Scanning Electron Microscopy
BIOEN 5602	Intro to BioImaging
BIOEN 6330	Principles of Magnetic Resonance Imaging
BIOEN 6401	Medical Imaging Systems
BIOEN 6500	Mathematics of Imaging
BIOEN 6640	Introduction to Image Processing
BIOEN 7310	Advanced Topics in Magnetic Resonance Imaging
BIOEN 7320	3-D Reconstruction Techniques in Medical Imaging
CS 5320	Computer Vision
CS 5962	Programming for Engineers
CS 5963	Introduction to Data Science
CS 7640	Advanced Image Processing
PHYS 3730	Intro To Computing In Physics
ENG 5020/6020	Emerging Technologies and Entrepreneurship

5.5 Biomaterials Engineering Track

BIOEN 5501	Biomimetic Materials Engineering
BIOEN 5601	Scanning Electron Microscopy
BIOEN 6002	Molecular Biophysics
BIOEN 6302	Biomaterials II
BIOEN 6303	Cell and Tissue Engineering: Stem Cells in Tissue Engineering
BIOEN 6305	Cell and Tissue Engineering: Organ Systems Design
BIOEN 6304	Polymers and Biopolymers
BIOEN 6405	Nanomedicine
BIOEN 6422	Biomedical Applications of Micromachining
CH EN 6853	Thermodynamics
CH EN 3453	Heat Transfer
CH EN 5103	Biochemical Eng.
CH EN 5810	Nanoscience
MSE 2010	Introduction to Materials Science & Engineering
MSE 3010	Materials Processing Laboratory
MSE 3310	Introduction to Ceramics
MSE 3011	Structural Analysis of Materials
MSE 3210	Electronic Properties of Solids
MSE 3410	Introduction to Polymers
MSE 3510	Introduction to Metallic Materials
MSE 5010	X-ray Diffraction Techniques
MSE 5035	Electron Microscopy Techniques
MSE 5061	Transport Phenomena in Materials Science and Engineering
MSE 5201	Semiconductor Device Physics I
MSE 5202	Semiconductor Device Physics II
MSE 5211	Semiconductor Device Fabrication Laboratory I
MSE 5212	Semiconductor Device Fabrication Laboratory II
MSE 5240	Principles and Practice of Transmission Electron Microscopy
MSE 5353	Physical Ceramics
MSE 5354	Processing of Advanced Ceramics
MSE 5471	Polymer Processing
MSE 5475	Introduction to Composites
ME EN 2010	Statics
ME EN 2030	Dynamics
ME EN 5060	Sustainable Products and Processes
MET E 1620	Introduction to Physical Metallurgy
MET E 3530	Experimental Techniques in Metallurgy
MET E 5260	Physical Metallurgy I
MET E 5450	Mechanical Metallurgy
MET E 5600	Corrosion Engineering
ENG 5020/6020	Emerging Technologies and Entrepreneurship

5.6 Biomechanical Engineering Track

BIOEN 5250/6250	Biomechanics II (treat as a required class)
BIOEN 5601	Scanning Electron Microscopy
BIOEN 6230	Functional Anatomy for Engineers
BIOEN 6421	Fundamentals of Micromachining
BIOEN 6480	Biomechanics Research
BIOEN 7210	Biosolid Mechanics
CH EN 6853	Thermodynamics
CH EN 3453	Heat Transfer
CS 3200	Introduction to Scientific Computing
CS 5962	Programming for Engineers
CS 5963	Introduction to Data Science
MATH 3150	PDEs for Engineers
ME EN 5250	Programming for Engineers
ME EN 5510	Introduction to Finite Elements
ME EN 2650	Manufacturing for Engineering Systems
ME EN 2010	Statics
ME EN 2030	Dynamics
ME EN 3300	Strength of Materials
ME EN 3610	Thermodynamics
ME EN 3650	Heat Transfer
ME EN 3710	Fluid Mechanics
ME EN 5010	Principles of Manufacturing Processes
ME EN 5060	Sustainable Products and Processes
ME EN 5300	Advanced Strength of Materials
ME EN 5500	Engineering Elasticity
ME EN 5520	Composites
ME EN 5720	Comp. Fluid Mechanics
ME EN 5960	Product Safety
ME EN 6200	Classical Control Systems
ME EN 6205	System Dynamics
ME EN 6220	Robotics
PHYS 3730	Intro To Computing In Physics
ENG 5020/6020	Emerging Technologies and Entrepreneurship

5.7 Computational and Informatics Track

BIOEN 6005	Computational Neuroscience
BIOEN 6640	Introduction to Image Processing
BIOEN 6670	Genomic Signal Processing
BIOEN 6760	Modeling and Analysis of Biological Networks
CH EN 5353	Computational Fluid Dynamics
CH EN 6703	Applied Numerical Methods
CS 1410	Object-Oriented Prog
CS 2100	Discrete Structures
CS 2420	Introduction to Algorithms & Data Structures
CS 3100	Models of Computation
CS 3200	Introduction to Scientific Computing
CS 3500	Software Practice I
CS 3505	Software Practice II
CS 3810	Computer Organization
CS 4150	Algorithms
CS 4300	Artificial Intelligence
CS 4960	Intro. Computational Geometry
CS 4964	Math for Data
CS 5150	Advanced Algorithms
CS 5300	Artificial Intelligence
CS 5310	Robotics
CS 5320	Computer Vision
CS 5340	Natural Language Processing
CS 5350	Machine Learning
CS 5530	Database Systems
CS 5540	Human/Computer Interact
CS 5540	Human/Computer Interaction
CS 5600	Introduction to Computer Graphics
CS 5610	Interactive Computer Graphics
CS 5630	Scientific Visualization
CS 5650	Visual Perception from a Computer Graphics and Visualization Perspective
CS 5962	Programming for Engineers
CS 5963/Math 3900	Introduction to Data Science
CS 5968	Algorithms & Approximation
CS 6210	Advanced Scientific Computing I
CS 6220	Advanced Scientific Computing II
CS 6320	3D Computer Vision
CS 6330	Intro to Robot Control
CS 6630	Visualization

5.7 Computational and Informatics Track (con't)

ECE 5340	Numerical Techniques in Electromagnetics
MATH 3150	PDEs for Engineers
MATH 3600	Mathematics in Medicine
Math 3900/CS 5963	Introduction to Data Science
MATH 5110	Mathematical Biology I
MATH 5120	Mathematical Biology II
MATH 5600	Survey Numerical Analysis
MATH 5610	Intr. Numerical Analysis I
MATH 5740	Mathematical Modeling
ME EN 5510	Introduction to Finite Elements
PHY 3730	Intro To Computing In Physics
ENG 5020/6020	Emerging Technologies and Entrepreneurship

5.8 Premedical Track

Students planning on applying to medical school may wish to design a set of BME electives that supports this goal. The BME electives selected should meet, to the extent possible, three criteria:

1. Students complete course requirements set by the medical schools for admission;
2. The selected courses are from a subject area in which the student performs well;
3. The courses provide the student a sound foundation for an alternative career choice should the medical schools not respond favorably.

The BS program in Biomedical Engineering generally meets all the course requirements for medical school with the exception of Organic Chemistry II (lecture and laboratory) and laboratories in introductory courses in Biology. However, the Biomedical Engineering core courses taken in the junior and senior years supply laboratory course hours which may be accepted in lieu of these explicit laboratory courses. Some medical schools also require an upper division writing course, *i.e.*, they do not accept the Thesis Writing and Communications series BIOEN 4201/4202 as equivalent.

Because there is considerable variability in what is both recommended and required among different medical schools, students should review the entrance requirements of the medical schools to which they are considering applying and determine which of the following courses (or equivalent) to include in their BME electives. They should also schedule advisory visits with Dr. Susan Bock, the special advisory for pre-medical students.

BIOEN 5480	Ultrasound
BIOEN 5602	Intro to BioImaging
BIOEN 6000	Systems Physiology I: Cardiovascular System
BIOEN 6303	Cell and Tissue Engineering I
BIOEN 6305	Cell and Tissue Engineering II
BIOEN 6401	Medical Imaging Systems
BIOEN 6230	Functional Anatomy for Engineers
BIOEN 6430	Systems Neuroscience
BIOEN 6405	Nanomedicine
BIOEN 6440	Neural Engineering
BIOEN 6600	Biomedical Technology in Anesthesia and Critical Care
BIOL 2030	Genetics
BIOL 3215	Cell Biology Lab
BIOL 3230	Developmental Biology
BIOL 3510	Biological Chemistry I (highly recommended)
BIOL 3515	Biological Chemistry Lab
BIOL 3520	Biological Chemistry II
CHEM 2320	Organic Chemistry II (a required class for medical school)
CHEM 2325	Organic Chemistry II Lab (a required class for medical school)
PATH 5030	Basic Immunology
MATH 3600	Mathematics in Medicine
PHYS 2215	Physics Lab I for S & E
PHYS 2225	Physics Lab II for S & E

5.9 Department of Bioengineering courses approved for inclusion as BME electives

Essential all course offered by Bioengineering outside the required core classes in the BME program are recommended and approved for inclusion in the BME electives plan. This course list is changing constantly and course offerings change in other departments so please consult with the Major Advisor whenever making a decision on the BME elective. **It is up to the individual student to ensure that the BME elective courses exist and are offered at the time the student wishes to take them. Note that many courses are taught only every second year.** For the most updated list of course offered by the department visit the “Course List” page on the department web site

5.10 Courses NOT acceptable for inclusion as a BME elective

The following courses are not acceptable as a BME elective. The reasons for excluding courses include:

- course does not include adequate engineering or biomedical content;
- course overlaps too much with a course already in the core curriculum of the BME program;
- course level, requirements, or evaluation are not equivalent to the rest of the BME program;
- course does not require active participation of the student

BE 4999	Honors Thesis/Project
BE 5950/6910	Independent Study
BE 6090/1	Department Seminar
BE 6062	Biomedical Engineering Literature Survey
BE 6464	Cardiac Electrophysiology and Biophysics Seminar*
BE 6900	Special Topics**
BE 6930	Special Project
MSE 2160	Elements of Materials Science and Engineering Take MSE 2010 instead (Introduction to Materials Science & Engineering)
MSE 2170	Elements of Materials Science and Engineering Take MSE 2010 instead (Introduction to Materials Science & Engineering)
ME 5960	Project Management
PHYS 3110	Physics of the Human Body I
PHYS 3111	Physics of the Human Body II
PHYS 2015 and 2025	Physics I/II Labs (take the Engineering and Sciences versions PHYS 2215/2225 instead). Language training courses

* students may take these courses for BME electives credit only if they otherwise have adequate numbers of hours but need to achieve the required number of college hours.

** Special topics class may count as BME electives, depending on the type and structure of the course. Please see the Major Advisor **before** taking a special topics class to determine its status.

BioInnovate classes: The following courses are part of the graduate BioInnovate program and are open only to MS/PhD students in that program. They **do not** qualify as BME electives.

6081	bioInnovate I
6082	bioInnovate II
6181	Clinical Problem Solving Through Strategic Analysis I
6182	Clinical Problem Solving Through Strategic Analysis II

6 Thesis Writing and Communications Project

A major component of the undergraduate program is the senior thesis project, which involves two components:

1. A substantial involvement (approximately 200 hours) in one of three activities:
 - A scientific research project supervised by a faculty member either in or affiliated with the Bioengineering Department. Students should register for BIOEN 4200 while they are engaged in this research project; the advisor for the project will set the grade.
 - A design project that extends above and beyond the scope of the Bioengineering Design Course, mentored by a Bioengineering faculty member. Students should register for BIOEN 4200 while they are engaged in this design project; the advisor for the project will set the grade.
 - A substantial design or research project undertaken as part of an industrial or academic internship. Students participating in an industrial internship or performing research at a remote location should register for BIOEN 4200; in both cases, the Major Advisor will set the grade.
2. Completing the Thesis Writing and Communications series (BE 4201/02).

The goals of the senior project are to develop specific experience and skills in scientific research and/or engineering design and development and to learn to present the results of such a study in all forms: written, oral, and visual. For most students, the senior project should be the culminating activity of their program in which they use skills acquired from numerous courses and previous laboratories and develop a whole new set of abilities in the science (and art) of organizing and presenting ideas.

Success in the senior project requires taking the following steps:

1. As the very latest in the spring of the Junior year, obtain a placement in a research lab, with a biomedical engineering form, or in a lab related to the design class project.
2. Discuss with a mentor the specific needs of the senior project and develop a plan to carry out a project of adequate scope to generate the results for the senior project.
3. Make sure that by the **beginning of the fall semester** in the Senior year, there are enough results/data to write and talk about in the Thesis Writing and Communications class BE 4201.

6.1 Research opportunities

The program encourages all students to take advantage of opportunities to pursue a project in a research lab on the campus. Such projects are typically the basis for the data needed for the Thesis Writing and Communications class BE course series but can also become a source of employment or the starting point of a research career.

A typical dialog with a student about pursuing research opportunities might go as follows:

Student: "I have a few questions concerning the senior project that I am hoping you can help me with: "Does my project need to be related to the bioelectric engineering track I chose? "

Advisor: "Heavens, no! Often the point of the project is to delve into some biological system or applications area that is new to you. Or to simply see how a lab operates."

Student: "Does the project need to be solely my own work or can I build my project off of previous research?"

Advisor: "We always assume that senior projects are pieces of a larger project; most research we engage in is like this actually. The main thing is to be sure you understand the larger project and how your piece fits. You can make this context clear in your writing and your presentations."

Student: “Would you recommend using the design project as the senior project? What are the advantages and disadvantages of choosing this option?”

Advisor: “This is a path less traveled and so we are still gaining experience on how to make this work. We have perhaps 1 student per year who has decided on this option. I think all students benefit from a true lab experience, especially those considering medical or graduate school. The design experience also has value but all things about the specific project have to be just right for it to work out well as a senior project.”

Student: “Are you aware of any lab openings within the bioengineering department that could help me get started on a project? If so, how is the best way to contact them?”

Advisor: “We don’t keep lists of openings but rather respond to students approaching us by creating projects such students could work on. Some faculty place limits on the number of UG students they have in the lab at any given time, while others are more flexible. So the best approach is to identify those faculty who pursue research that you find motivating and interesting. The department web site is a good place to start such a search, in the directory by research area section:

www.bioen.utah.edu/research/faculty_by_technical_area.php

Once you have narrowed the search, contact some professors by email and ask them for an appointment to discuss possible senior projects they might have. It is helpful to come to the interview informed from reading some of the professor’s papers, enough to at least have an idea of the research and some questions prepared. Then see what options emerge.”

Student: “I am concerned that since it is the spring of my Junior year, I am behind in getting started on this, so I would appreciate any help you could give me in getting started.”

Advisor: “If you start aggressively now with the plan of working over the summer on the project, then you should be fine. But do start NOW and feel free to contact me again with more questions or to get suggestions.”

If there are questions or uncertainty at any step in the process, the Major Advisor is available to help.

7 B.S./M.S. Program

The Department offers for students interested in rapidly advancing to the Master’s level a combined B.S./M.S. program. The program is described in a separate document on the Department website and students interested in the program should read this description carefully to ensure that their course of study complies with the requirements. It is essential to set up an appointment with the B.S./M.S. program coordinator to arrange the application and work out details.

Note that international students on visas are not eligible to participate in the combined BS/MS programs, per SEVIS regulations according to the U.S. Immigration and Customs Enforcement (URL: www.ice.gov/sevis).

8 Forms

The form on the following pages is also available in paper form from the undergraduate advisor and coordinator.

New for 2015: To submit proposed BME electives, please use the electronic forms available at <http://ugforms.bioen.utah.edu>.

**Department of Bioengineering
Application for Admission to Major Status in Biomedical Engineering (2016/17)**

Instructions: To earn a Bachelor of Science in Biomedical Engineering, you must normally be admitted to major status before registering for upper-division Biomedical Engineering courses. To be considered for major status, as a minimum, each of the courses listed below must be passed with a straight C grade or better, the GPA among the courses listed below must be at least a 3.35, and the cumulative U of U GPA must be at least a 3.0. If any of these criteria are not met, your application may not be considered.

Applications are due between November 1 and December 31 of every year; **late applications will not be considered.**

For classes in progress at the time the application is submitted, DO NOT include a grade. However, DO indicate the semester and year a course is being taken. Indicate if you intend to apply for an Honors designation on your Bachelor Degree.

Write legibly, and ensure that all grades included on the application are correct. Grades will be verified, and any inaccuracy may disqualify the application.

This application can be submitted on hard copy or emailed to Page Bailey.

Name: _____ Student No. _____
 Address: _____ Phone: _____
 _____ Email: _____

Intention to apply for Honors designation Y / N? _____

Course	Letter Grade	Grade Value*	x	Credit Hours	=	Points	Semester/Year Taken
<i>(Example)</i>	<i>A-</i>	<i>3.70</i>	<i>x</i>	<i>3</i>	<i>=</i>	<i>11.10</i>	<i>Fall 02</i>
BIOEN 1010	Careers in Biomedical Engineering	_____	N/A	N/A	=	N/A	_____
BIOEN 1020	Fund. of Bioengineering I	_____	x	3	=	_____	_____
BIOEN 2100	Fund. of Bioengineering II	_____	x	4	=	_____	_____
BIOL 2020	Cell Biology	_____	x	3	=	_____	_____
CHEM 1220	General Chemistry II	_____	x	4	=	_____	_____
CHEM 1225	General Chemistry II Lab	_____	x	1	=	_____	_____
MATH 2250	Diff. Equations & Linear Algebra	_____	x	4	=	_____	_____
MATH 1321	Accel. Eng. Calc II	_____	x	4	=	_____	_____
or MATH 2210	Calculus III	_____	x	3	=	_____	_____
PHYS 2210	Physics for Scientist & Engineers I	_____	x	4	=	_____	_____
PHYS 2220	Physics for Scientist & Engineers II	_____	x	4	=	_____	_____
	Total			31 or 30s			

* Grade Values: A = 4.00, A- = 3.70, B+ = 3.30, B = 3.00, B- = 2.70, C+ = 2.30, C = 2.00

A GPA from courses above (Total Points / Total Credit Hours): _____

B U of U Cumulative GPA reported on transcript (adjusted to include transfer grades weighted by hrs.): _____

Student Signature: _____ Date: _____

Office use
 Confirmed: _____

Action date(s): _____ Admit _____ Wait list _____ Decline _____