



College of Engineering
UNIVERSITY OF WISCONSIN-MADISON

**DEPARTMENT OF
BIOMEDICAL ENGINEERING
(BME)**



**Undergraduate Student
Curriculum Handbook**

Fall 2017-Present

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ABOUT THE BIOMEDICAL ENGINEERING UNDERGRADUATE PROGRAM

Motto

Better health by design!

Vision

To improve human health by integrating education, discovery, innovation and entrepreneurship.

Mission

The Department of Biomedical Engineering motivates and prepares students to engage in life-long learning. Through the creation, integration, application, and transfer of engineering knowledge to medicine and biology, we have a significant and far-reaching impact on human health. We cultivate an environment that nurtures and promotes the development of our faculty, staff, trainees, and students as professionals and leaders.

Program Educational Objectives

We recognize that our graduates will choose to use the knowledge and skills that they have acquired during their undergraduate years to pursue a wide variety of career and life goals, and we encourage this diversity of paths. Whatever path graduates choose, be it a job, postgraduate education, or volunteer service, be it in engineering or another field, we have for our graduates the following objectives; that they will:

1. exhibit strong skills in problem solving, leadership, teamwork, and communication;
2. use these skills to contribute to their communities;
3. make thoughtful, well-informed career choices; and
4. demonstrate a continuing commitment to and interest in their own and others' education.

Student Outcomes

We expect that our graduates will have:

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

The undergraduate program educational objectives are reviewed and approved by the BME faculty at least once annually. Our student's attainment of the ABET and *BME specific* student outcomes are assessed annually by our Assessment Committee in our design curriculum. These are also available online: <https://www.engr.wisc.edu/department/bme/about/>.

What is Biomedical Engineering?

Biomedical Engineering (BME) is the application of engineering tools for solving problems in biology and medicine. It is an engineering discipline that is practiced by professionals trained primarily as engineers who specialize in medical and biological applications. As engineers, BMEs are engaged in design and problem solving. BME is an interdisciplinary profession with teams consisting of engineers, physicians, biologists, nurses and therapists. BMEs assert their multidisciplinary expertise for designing new medical instruments and devices, applying engineering principles for understanding and repairing the human body, and for decision making and cost containment using engineering tools.

Admission and Progression

Students are directly admitted to the College of Engineering (COE), Department of Biomedical Engineering (BME). At the end of the first year, students are required to confirm their intent to stay, change majors, or join BME. Automatic progression occurs for first year COE students when Regulation 3 is met: <http://enr.wisc.edu/progression>. If the automatic GPA is not met or the student enters from outside of the COE, students are considered for admission using a holistic review process which includes review of their written statement, rigor of completed courses, and grade trends. The department believes this process is important in creating a strong and diverse class of BME students. Once progression is met, no further admission or progression checks take place, provided the students remain in good standing.

Students successfully completing the BS degree, with an overall GPA of 3.0 or a GPA of 3.25 for the last 60 credits of the B.S. degree program, are eligible to apply for the one-year M.S. or the Ph.D. degree programs.

Department Climate

Diversity is a source of strength, creativity, and innovation. All students, staff and faculty in this department are expected to value the contributions of each person and respect the ways in which their identity, culture, background, experience, status, abilities, and opinion enrich our learning experience and university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.

The University of Wisconsin Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background - people who as students, faculty, and staff serve Wisconsin and the world.

Advising

Students directly admitted to the BME Department are assigned a staff advisor who will in most cases remain their advisor throughout their undergraduate career. Once progressed, students are also assigned a faculty advisor. See [contacts](#).

Key Features of BME at UW-Madison

The BME undergraduate degree emphasizes engineering design in preparation for employment in biomedical industries and for graduate or medical school study (Figure 1). Novel aspects of the undergraduate program include: real-world, client-based design projects throughout the curriculum advised by BME faculty mentors (Figure 2); opportunities for industry cooperatives, internships and study abroad experiences; continuous advising; flexibility in engineering specialization areas; student involvement in program evaluation and improvement; and an option to complete an M.S. degree in just one year after the B.S. degree. The BME curriculum also enables a student to prepare for medical school in four years.

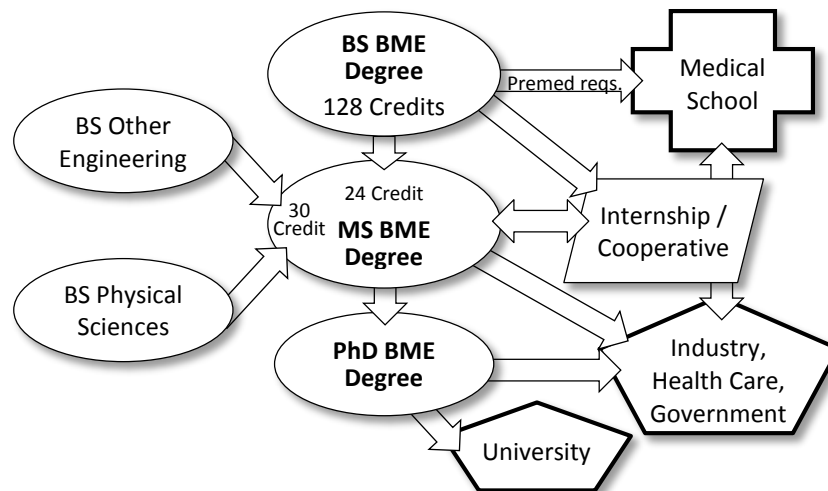


Figure 1: BME Degree Program and Career Paths.

Design throughout the Curriculum

The undergraduate program was founded with design at the heart of the curriculum (Figure 2) in which students have the opportunity to apply the knowledge that they are gaining in their other courses to the design process and to discover the relevance of the material that they are learning. This design sequence breaks down class boundaries, forms mentored relationships, actively involves each student in the evolution of the design course and department, and engages the students in active learning.

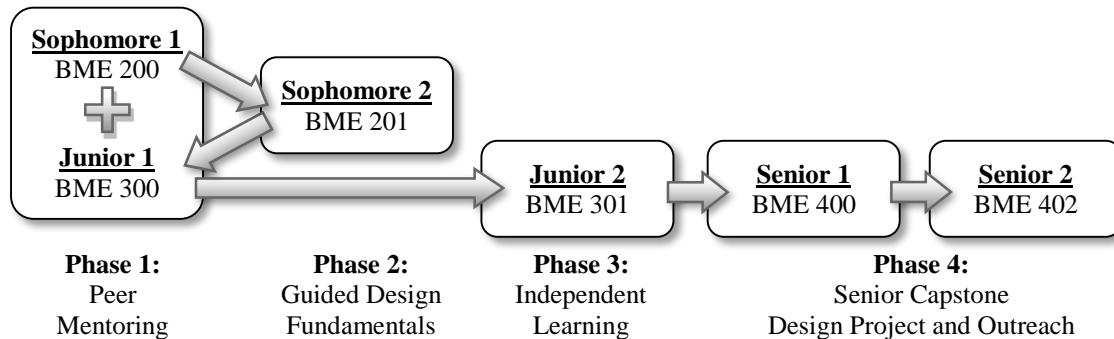


Figure 2: BME design course sequence throughout the curriculum. During **Phase 1**, juniors are teamed with and mentor the sophomores; **Phase 2** sophomores work on a guided design project, learning both professional and hands-on technical skills needed to solve a multidisciplinary project; **Phase 3** allows juniors to work independently on a project which can carry forward to **Phase 4**, a yearlong more complex project for capstone design.

Students work in teams of four to six to solve biomedical engineering design problems. In each of client-based design courses, the students choose a real-world project from a client list composed of faculty throughout the university (particularly engineering, medical and life sciences), clinicians, people with specific biomedical challenges, and industry. Teams are advised closely by the "Design Faculty" which is a group of Biomedical Engineering faculty and instructors who oversee and meet weekly with two-four projects each. In each semester, three of the six design courses are running. The current projects for the semester can be found online: <http://bmedesign.engr.wisc.edu/>

BME 200 (Fall) – First-semester sophomores are teamed-up with, mentored and in part advised by first-semester juniors while solving a real-world medical challenge. This model promotes peer-to-peer learning and enhances leadership qualities.

BME 201 (Spring) – Guided Design Fundamentals - second-semester sophomores work in teams to solve a guided project using multidisciplinary hands-on technical (electronic circuits, programming, 3D modeling in SolidWorks, machining, and laboratory techniques) and professional design-based skills taught during the lecture and laboratory sessions.

BME 300 (Fall) – First-semester juniors have the opportunity to teach the sophomores something they have learned – the design process. They also serve as big brothers/sisters advising the younger students on the curriculum. This develops a spirit in the students of being part of a group that is bigger than their own class.

BME 301 (Spring) – Second-semester juniors start a more difficult design project that could lead toward their senior capstone design course. The intent is to instill in them the confidence to complete the design process on their own.

BME 400 (Fall) – First-semester seniors complete and implement a more complicated design. They perform extensive research to fully develop and test their design. They begin to work toward filing a patent and preparing a publication.

BME 402 (Spring) – Final-semester seniors test, evaluate and improve their device and produce final documentation. All students complete an outreach requirement typically by giving a talk or organizing a hands-on activity in a K-12 classroom. They also write a technical paper in a journal format and if applicable, file for a patent and/or submit to a conference.

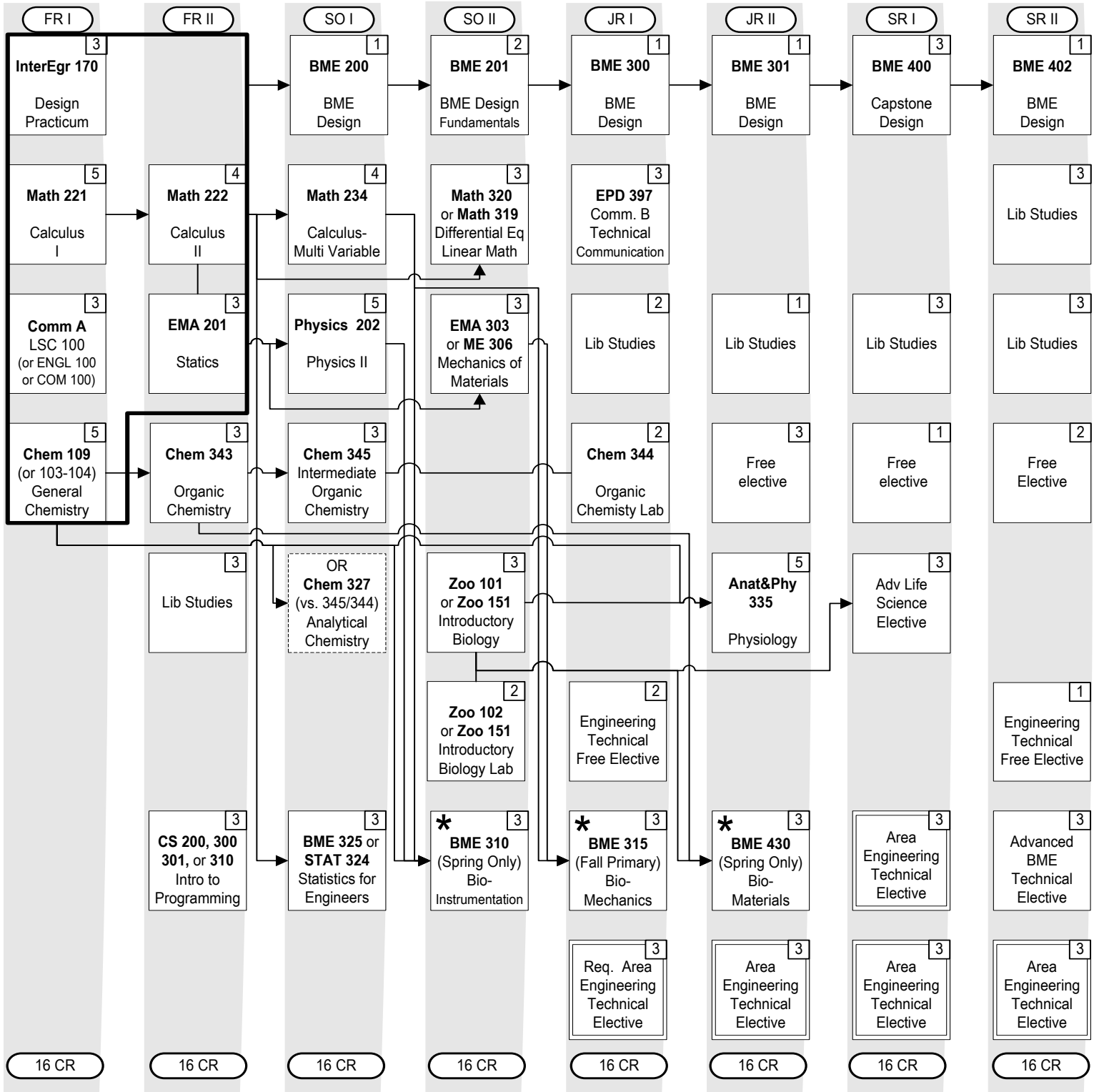
Each team designates a member to fill the following roles, with the goal that every student holds each role at least once:

1. **Team leader** Responsible for weekly progress reports and organization of team meetings and team responsibilities.
2. **Communicator** Primarily responsible for communications with client and other professional contacts.
3. **BSAC** (Biomedical Student Advisory Committee) provides feedback to faculty about design courses and curriculum.
4. **BWIG** (Biomedical Web Implementation Group) is responsible for the team's web site.
5. **BPAG** (Biomedical Purchasing and Accounting Group) is responsible for the team's finances.

The BME Design Curriculum is therefore a unique, six-semester, hands-on, client based, real-world undergraduate learning experience. Clients are solicited from health care, local industry, life sciences and clinical faculty and the community.

Important Note to incoming students to the BME Program: These design classes are Friday's from 12-2pm – save this space.

General Curriculum Flowchart



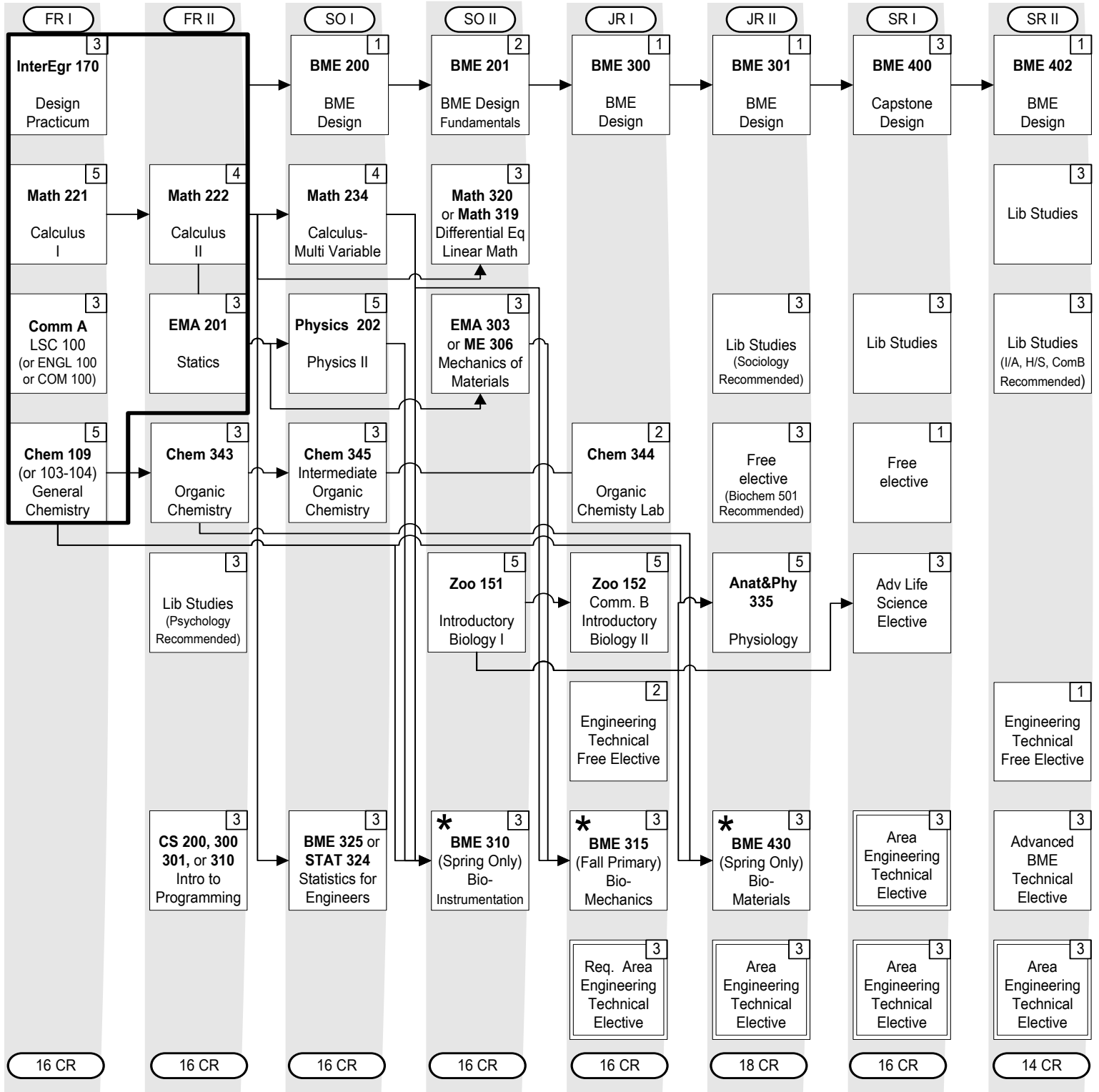
□ General College Requirements (GCR): To be admitted / progress into BME, the GCR must be satisfied which includes four core-courses. There are different options to fulfill the GCR courses, these are the recommended courses for BME: <http://progression.engr.wisc.edu>

⊞ Chemistry Requirement: Choose Chem 343: Organic chemistry as the pre-req for Chem 344-345: Intermediate Organic Chemistry and Lab. You may take Chem 327 or 329 Analytical chemistry instead of 344/5 in which case Chem 341 is sufficient in place of Chem 343. You may NOT take Chem 341 and then 344-345.

▣ Engineering Area Technical Electives: At least 15 credits from ONE of the following BME tracks (including one required area elective): 1. Bioinstrumentation & Medical Devices (ECE 230-circuits), 2. Biomedical Imaging & Optics (ECE 330-signals), 3. Biomechanics (EMA 202 or ME 240-dynamics), or 4. Biomaterials, Cellular, & Tissue Engineering (BME 330-engr principles of cells, molecules, & tissues or CBE 320).

***** Required core courses: All three core courses with labs are required. It is advisable to take them in order of interest. For example, take BME 430 first in the sophomore year if you wish to enter the biomaterials track. In this case, it is advisable to take biology sooner.

Advanced Biology Flowchart (Fulfills Pre-Med Requirements)



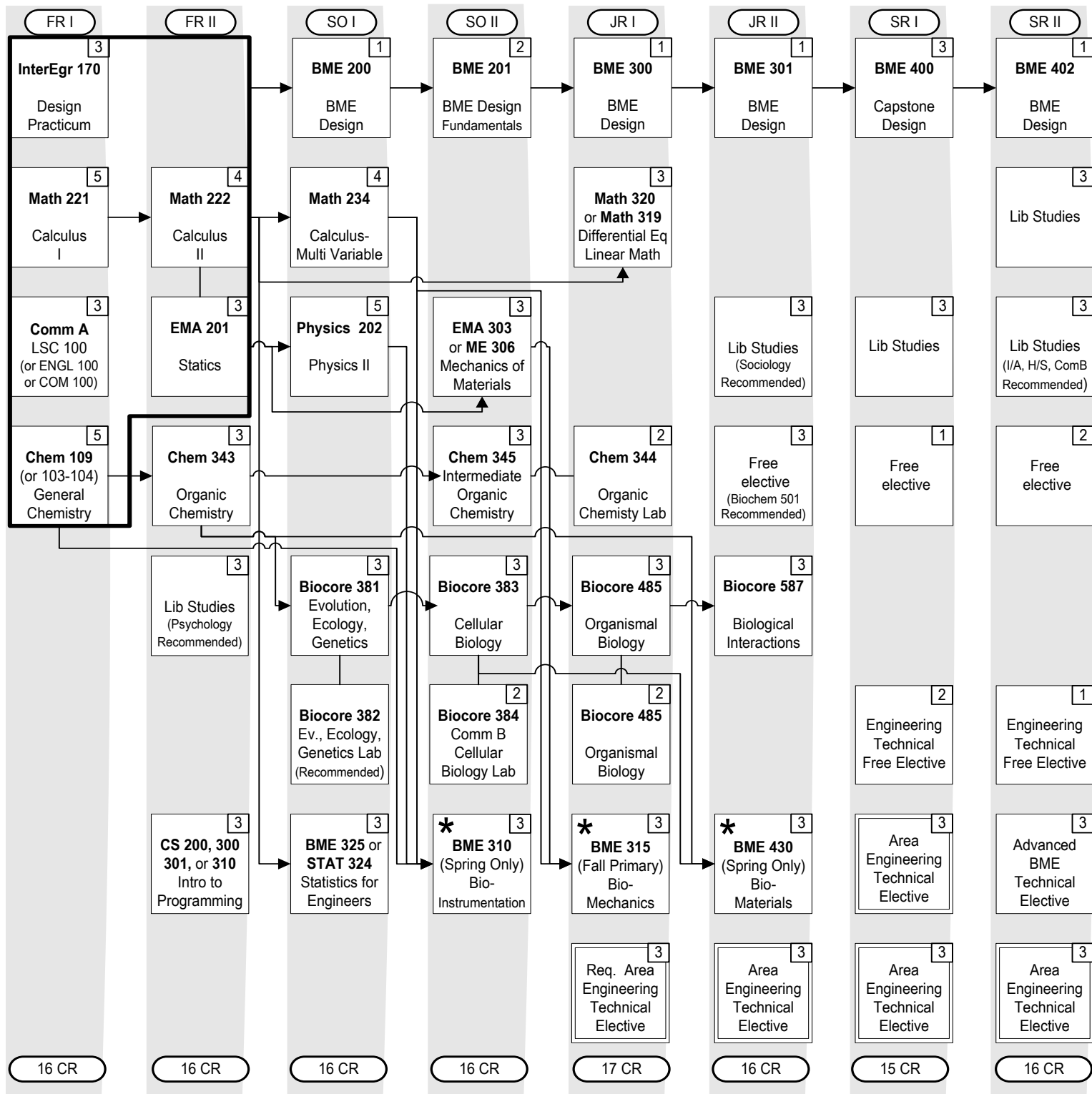
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* **Required core courses:** All three core courses with labs are required. It is advisable to take them in order of interest. For example, take BME 430 first in the sophomore year if you wish to enter the biomaterials track. In this case, it is advisable to take biology sooner.

Medical School Requirements: All pre-med and MCAT requirements are built into the curriculum by taking the courses recommended above. Note, some courses are not "required" by your BME Degree, instead free elective or liberal elective credits are notated as "recommended" such as Biochemistry 501, Psychology, and Sociology. Medical schools have specific requirements – it is recommended to identify these early.

BIOCORE Honors Flowchart (Fulfills Pre-Med Requirements)



General College Requirements (GCR): To be admitted / progress into BME, the GCR must be satisfied which includes four core-courses. There are different options to fulfill the GCR courses, these are the recommended courses for BME: <http://progression.engr.wisc.edu>

Engineering Area Technical Electives: At least 15 credits from **ONE** of the following BME tracks (including one required area elective):
 1. Bioinstrumentation & Medical Devices (ECE 230-circuits), 2. Biomedical Imaging & Optics (ECE 330-signals), 3. Biomechanics (EMA 202 or ME 240-dynamics), or 4. Biomaterials, Cellular, & Tissue Engineering (BME 330-engr principles of cells, molecules, & tissues or CBE 320).

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UNDERGRADUATE CURRICULUM REQUIREMENTS

To receive a B.S. degree in biomedical engineering, you must first complete the General College Requirement (GCR) and progress into the department. The degree will be granted after completing the following requirements ([BME on UW-Guide](#)):

BME Major Requirements – 128 credits

1. Mathematics:
 - a. Calculus: Math 221, Math 222, and Math 234
 - b. Advanced math elective: select Math 320 (or 319)
 - c. Statistics elective: select BME 325, STAT 324 (or Math 431)
2. Science:
 - a. Computer science elective: select CS 200 (Java I), 300 (Java II), 301 (Python), or CS 310 (MatLAB)
 - b. Physics: EMA 201 (Statics) and Physics 202 or 208. (Note: EMA 201 is recommended over Physics 201/207)
 - c. Chemistry: select Chem 109 (or Chem 103 and 104)
 - d. Organic chemistry elective: select Chem 343 (or Chem 341)
 - e. Advanced chemistry lab elective: select Intermed. Organic Chem 344-345 or Analytical Chem 327 (or 329)
 - f. Biology elective: select Zoology 101-102, or Zoology 151, or Biocore 381, 383-384, or (AP Biology score 4+)
 - g. Physiology/Systems Biology: select Anat&Phys 335 (or 435 limited availability) or Biocore 485 and 486
 - h. Advanced life science elective: select one: Anat&Phys 337 (Anatomy is not a good choice for premeds), Zoology 430, Zoology 470, Zoology 523, Zoology 570, Zoology 611, Biocore 587, or Genetics 466
3. General Education:
 - a. Communication A (Comm A): select LSC 100, ENGL 100, COM 100, ESL 118, or Placement or AP Score
 - b. Communication B (Comm B): select EPD 397, or Zoology 152, or Biocore 384
 - c. At least 15 credits of liberal studies electives following the College of Engineering guidelines on page 13
4. Engineering courses: at least 48 credits (cr.) selected from any degree-granting engineering program including:
 - a. 3 cr. Introduction to engineering: InterEGR 170
 - b. 6 cr. Required engineering mechanics core courses: EMA 201 and EMA 303 or ME 306
 - c. 18 cr. Required BME core courses: BME 200, 201, 300, 301, 310, 315, 400, 402, and 430
(during a cooperative experience BME 001 may be used to replace only BME 200, 300, or 301)
 - d. 15 cr. Engineering area technical electives (see below)
 - e. 3 cr. One advanced BME technical elective from any area selected from an approved list of courses
 - f. 3 cr. Any engineering course (technical elective) from a degree-granting engineering program
 - i. EPD and InterEGR courses are not included in this category except (InterEGR 301)
 - ii. Only 3 credits of an engr independent study may count (i.e. BME 399, 389, 489, CBE *99, etc.)
 - iii. Special topics courses must have prior approval of the BME Curriculum Committee

Engineering Area Technical Elective Requirements

Choose 15 credits of area technical electives in one of the following five tracks and at least one advanced BME elective:

1. **Bioinstrumentation and medical devices:** Required area elective: ECE 230 - Circuit Analysis
Advanced BME Area technical electives in the area: BME 462, 463, 535, 550, 556
Other area electives: any ECE course
2. **Bio-Imaging and Optics:** Required area elective: ECE 330 - Signals and Systems
Advanced BME Area technical electives in the area: BME 530, 535, 568, 619, 650
Other area electives: ECE 203, 331, 431, 533; BME 566-574; NE 305, 408, 427, 506
3. **Biomechanics:** Required area elective: EMA 202 or ME 240 - Dynamics
Advanced BME Area technical electives in the area: BME 415, 416 (603), 505, 564, 615, 662
Other area electives: any ME or EMA course; ISyE 349, 549, 552, 555, 559; MS&E 350/1; CBE 320/30, 324, 525
4. **Biomaterials/Cell/Tissue Eng:** Required area elective: BME 330 - Engineer Principles of Cells, Molecules & Tissues or BME 320 - Transport Phenomena (note CBE 250 is not needed as a prerequisite)
Advanced BME Area technical electives in the area: BME 505 510, 520, 545, 550, 556, 615
Other area electives: any CBE course; any MS&E course; ME 417, 418; BME 511

[Recommended list of courses](#) for each track be found at this link.

Note that the recommended lists of courses are for advisory purposes only so that students can put together a comprehensive set of related courses. Tracks are defined below and can further be divided into sub-areas to help define how courses fit into a topic area(s).

Bioinstrumentation and Medical Devices

Bioinstrumentation is the application of electronics, measurement principles, and techniques to develop devices used in diagnosis and treatment of disease. Examples include the electrocardiogram, brain-computer interface, implantable electrodes, sensors, tumor ablation and other medical devices. Neuroengineering, a sub-field, involves using engineering technology to study the function of neural systems and the development of implantable technology for neuroprosthetic and rehabilitation applications.

Bioelectronics: Capture and amplify physiological signals by designing circuits

Biosignals: Implement frequency and time domain algorithms to analyze physiological signals

Bicomputing: Design and program microprocessor-based “smart” instruments

Recommendations: Computer Science 200, 300 and 400; the computer science certificate; analytical Chemistry 327 instead of intermediate Organic Chemistry; Adv. Life Science: Zoology 523

Biomedical Imaging and Optics

Biomedical imaging and optics involves the design and enhancement of systems for noninvasive anatomical, cellular, and molecular imaging. In addition to common imaging techniques such as magnetic resonance imaging (MRI), computed tomography (CT), and positron emission tomography (PET), biomedical imaging includes topics such as biophotonics, optics, and multimode imaging, and is now expanding to serve functional and therapeutic purposes as well. Advanced capabilities result when fundamentals of engineering, physics, and computer science are applied in conjunction with the expertise of clinical collaborators.

Medical Radiation Physics: Design systems for radiological sciences, radiation therapy, and health physics

Recommendations: Computer science 301 or 310, Physics 241 (3 credits) taken as a free elective; Physics/MedPhysics 463 could also be considered for a free elective

Medical Image Science: Application of mathematics and physics related to all aspects of all medical imaging modalities

Recommendations: Computer Science 200, 300 and 400; the computer science certificate

Biomechanics

Biomechanics applies engineering mechanics for understanding biological processes and for solving medical problems at systemic, organ, tissue, cellular, and molecular levels. This includes the mechanics of connective tissues (ligament tendon, cartilage and bone) as well as orthopedic devices (fracture fixation hardware and joint prostheses), vascular remodeling (pulmonary hypertension), muscle mechanics with injury and healing, human motor control, neuromuscular adaptation (with age, injury, and disease), microfluidics for cellular applications, cellular motility and adhesion, and rehabilitation engineering (quantifying, adapting and restoring function for those who lost abilities).

Biodynamics: Moving systems, i.e. kinesiology-running mechanics

Biosolid Mechanics: The mechanics of orthopedics, materials, bone and tissue

Biofluid Mechanics: The mechanics of the vascular, cardiovascular and pulmonary systems

Recommendations: Computer Science 301 or 310; Adv. Life Science: Anatomy (Kines 337)

Biomaterials, Cellular and Tissue Engineering

Biomaterials are structural materials, derived from synthetic or natural sources that interact with tissue for medical therapeutic or diagnostic purposes. A wide range of materials are employed in biomedical devices such as artificial blood vessels, cardiovascular stents, heart valves, orthopedic joints, dental fillings, catheters, and drug delivery vehicles. Understanding material properties and their interaction with the body is vital in the use of biomaterials. Biomaterials are often utilized for Cellular and Tissue Engineering. Cellular engineering is an interdisciplinary field to study or manipulate biological processes at a cellular or even molecular level (such as the cell's differentiation, proliferation, growth, migration, and apoptosis). Tissue Engineers understand structure-function relationships in normal and pathological tissues to engineer living tissues and/or biological substitutes to restore, maintain, or improve function.

Hard Biomaterials: The study of materials such as ceramics or metallurgy for orthopedics

Soft Biomaterials: Designs such as for ocular implants or wound dressings using natural or hydrogel based materials

Cellular and Tissue Engineering: Cell-material interactions, engineering cell-based systems, or studying cell processes

Systems Biology: Operation of biological system as a whole-measuring, modeling, and probing component interactions

Recommendations: Computer Science: 301; Chem 344-345: Intermediate Organic Chemistry instead of Analytical Chemistry; Adv. Life Science: Cell Biology (Zoo 570), Animal Development (Zoo 470), BIOCORE

Advanced Biomedical Engineering (BME) Technical Electives

Students are required to take one advanced BME technical elective it is highly recommended to take this course in your area. Table 1 summarizes all the advanced BME technical electives offered, when they are offered and the areas they cover.

Table 1: Advanced BME technical electives and the semester(s) typically offered: F=Fall, S=Spring. All are 3 credits.

BI: Bioinstrumentation, IO: Bio-Imaging & Optics, ME: Biomechanics, TE: Biomaterials/Cellular/Tissue Engineering

x = Highly related to the area.

+ = Moderately related to the area.

Course BME #	Course Title	Pre-requisite	Sem.	BI	IO	ME	TE
415	Biomechanics of Movement	ME 240eq, 306eq, BME 315, Matlab	F			x	
603	Orthopedic Biomechanics (to be 414)	ME 306eq, BME315	evr 3			x	+
462	Medical Instrumentation	ECE 340	F	x			
463	Computers in Medicine	ECE 330, CS 302	S	x	+		
505	Biofluidics	EMA 201, 202eq, Phys 335	S			x	+
510	Introduction to Tissue Engineering	BME 430	F				x
520	Stem Cell Bioengineering	Math319, Zoo470/570, Chem343	S				x
530	Medical Imaging Systems	ECE 330, CS 302	S		x		
535	Introduction to Energy-Tissue Interactions	Physics 202, Math 319/20, Sr/Grd	F	x	x	x	+
545	Engineering Extracellular Matrices	Zoo101-2/151, BME430	S				x
550	Intro to Biological & Medical Microsystems	Zoo 101-2/151, BME 310	F	x			x
556	Intro to Systems Biology	Zoo570/BME510, Math319	S	+			x
560	Biochemical Engineering	CBE 310; CBE 320; Zoo 151	F				x
564	Occupational Ergonomics & Biomechanics	ISyE 349 or BME 315	S			x	
568	Magnetic Resonance Imaging (MRI)	Math 222, Physics 202	S		x		
615	Tissue Mechanics	BME 315	F			x	x
619	Microscopy of Life	Physics 202	F		x		+
662	Design and Human Disability and Aging	Junior	S			x	

Advanced Life Science Elective Choices

Students are required to select one Advanced Life Science Elective from the list in Table 2. Students are encouraged to use free electives to take more than one of these courses or other suggestions available in Table 3.

Table 2: List of acceptable Advanced Life Science Electives, the semesters they are typically offered and credits.

*Premeds: A rare few medical schools require an advanced life science elective with a lab. For these, students should select a course with an available lab. Premeds should not select Anatomy 328-329 as med schools require you to take anatomy in med-school unless you are applying to Ohio State where Anatomy is a pre-requisite for the application.

Course Number	Course Title	Semester	Credits	Optional Lab Section*
Anat&Phy 337*	Human Anatomy	F/S/M	3	Anat&Phy 329
Genetics 466	General Genetics	F/S	3	Genetics 545
Zoology 430	Comparative Anatomy	F	5	Not optional
Zoology 470	Intro. to Animal Development	S	3	Zoology 555
Zoology 523	Neurobiology	F/M	3	N/A
Zoology 570	Cell Biology	F	3	N/A
Zoology 611	Comparative Physiology	S	3	Zoology 612
Biocore 587	Biological Interactions	S	3	N/A

Liberal Studies Guidelines

The selection of courses to fulfill the 15 credits of Liberal Studies Electives follows the "College of Engineering Liberal Studies Guidelines" (<http://guide.wisc.edu/undergraduate/engineering/#requirements>) summarized as follows:

As a graduation requirement and to fulfill campus general education guidelines, all BME undergraduate students must take 15 credits that carry at least one breadth designator - H: Humanities, S: Social Science, L: Literature. This also includes courses such as - W: Social Science and Natural Science, X: Humanities and Natural Science, Y: Biological Sciences and Social Science or Z: Humanities and Social Science. These credits must fulfill the following sub-requirements:

- I. A minimum of two courses from the same department or program. At least one of these two courses must be above the elementary level (i.e., must have an I, A, or D level designator) as indicated in the Timetable.
- II. A minimum of 6 credits designated as humanities (H, L, X, or Z credit) and an additional minimum of 3 credits designated as social science (S, W, Y or Z). Foreign language courses count as H credits*.
- III. At least 3 credits in courses designated as ethnic studies (lower case "e" in the Timetable). These credits may help satisfy regulations I or II as well, but they count only once toward the total required.

*Exception: "Retro credits," which are credits awarded by foreign language departments for successful completion of a higher level course, do not count toward this requirement, nor toward the total of 15 credits required. They are still helpful: If a student takes even one foreign language course at the intermediate level and is awarded retrocredits, then requirement I above is satisfied, because the student is judged to have achieved "depth" in liberal studies.

Free Elective Suggestions

A total of 128 degree credits are required to graduate. Students may have 0-7 free elective credits depending on their course choices in the curriculum flow charts or advanced placement credits. While any course offered in the university may be counted, some suggestions related to BME include taking: additional area engineering electives or other engineering electives, additional independent study credits (students may count only three toward the required engineering credits), other advanced life science courses/labs in Table 2, or other life sciences courses in Table 3.

Table 3: List of life science courses as suggestions to fulfill any free electives needed to reach a total of 128 degree credits. *Biochem 501 is required for most medical schools, **Credit will not be given for both Chem 561 and 565.

Course Number	Course Title	Credits
Biochem 501*	Introduction to Biochemistry	3
Biochem 601	Protein and Enzyme Structure and Function	2
Biochem 602	Biochemical Mechanisms of Regulation in the Cell	2
Biochem 630	Cellular Signal Transduction Mechanisms	3
Biomolchem 314	Introduction to Human Biochemistry	3
Biomolchem 503	Human Biochemistry	3
Biomolchem 504	Human Biochemistry Lab	2
BMI 576	Introduction to Bioinformatics	3
Chem 561**	Physical Chemistry	3
Chem 562	Physical Chemistry	3
Chem 565**	Biophysical Chemistry	4
Chem 641	Advanced Organic Chemistry	3
CS 300	Programming II	3
CS 400	Programming III	3
CS 368	Learning a New Programming Language	1
MM&I 528	Immunology	3
MM&I 529	Immunology Laboratory	2
Zoology 524	Neurobiology II: Introduction to the Brain and Behavior	3

RULES AND REGULATIONS

College of Engineering Rules and Regulations

The complete set of Rules and Regulations can be found on the College of Engineering Webpage, the list below contains rules that are often inquired about by students in BME:

<https://www.engr.wisc.edu/rules-and-regulations/>

1-7. Admissions and Progression

8. Definitions

A. Full-time student:

One carrying at least a minimum credit load of 12 credits. All students are expected to be full-time unless they have the permission of the Dean to be part-time. A student carrying less than the minimum credit load without the Dean's permission will be placed on probation at the end of the semester.

B. Part-time student:

One who has the Dean's permission to carry less than a minimum credit load (Regulation 9.F.).

9. Credit Load Constraints

A. Maximum credit load

20 enrolled credits per semester.

B. Minimum credit load

12 enrolled credits per semester or enrolled for one cooperative education program credit as an engineering co-op student during a co-op work period.

F. Part-time student

A student who wishes to carry less than a minimum credit load in a specific semester for definitive reasons, e.g., a verifiable disability, or a necessity of employment or other outside obligations exceeding 15 hours per week, must request written permission from the Dean to become a part-time student. Part-time permissions must be renewed during the first two weeks of each semester. Part-time students must satisfy all regulations other than the minimum credit load. For any semester for which part-time permission is granted and the one following it, the academic status of the student is the responsibility of the student.

38. Graduation

It is the student's responsibility to ensure that graduation requirements have been met. All students should regularly consult their DARS (Degree Audit Reporting System) document in conjunction with their advisor to ensure that all the following graduation requirements are being met

- A. Have fulfilled the published graduation requirements of that curriculum, with all substitutions formally approved, and have achieved a minimum 2.0 gpa overall.
- B. Have a PCR (see Regulation 24) of at least 2.0 for those semesters and sessions containing the last 60 credits taken at UW-Madison or for all credits taken at Madison if fewer than 60.
- C. Have a departmental PCR of at least 2.0 for all courses taken in the degree-granting department that count toward graduation.
- D. Have completed at least 30 credits in residence in the College of Engineering, including 15 credits of work in the degree-granting department.
- E. Have completed the last two semesters in residence in the College of Engineering as a full-time student.
- F. Have a GPA of at least 2.0 both for the last semester and also for the combined last two semesters.

39. Graduation with Distinction and Highest Distinction

Students who have earned at least 60 credits on the University of Wisconsin-Madison campus and whose total cumulative GPA is in the top 5 percent of the College graduating class will receive the designation "Graduated With Highest Distinction," or if in the next 15 percent, "Graduated with Distinction." The appropriate designation is entered as a permanent record on the student's transcript.

SECOND MAJORS AND CERTIFICATES

Below is a list of common second majors and certificates earned by BME students. Second majors and certificates do not generate a second diploma nor do they appear on your primary diploma, they do however appear on the transcript. Once declared, a second Degree Audit Report (DARS) is created to track progress. It is recommend to review these options and the what-if DARS early to fully utilize the BME degree requirements, liberal studies, and elective toward both the BME Degree and the second major or certificate.

Second Majors

BME Students may earn a second major in the College of Letters and Science only. Second majors cannot be sought in engineering. Students should follow the (MAJ) option for the second major and thus do not need fulfill their general education requirements. For a complete list of majors visit <http://guide.wisc.edu/undergraduate/#majorscertificatestext>

Biochemistry

<http://guide.wisc.edu/undergraduate/letters-science/biochemistry/biochemistry-bs/>

Double majoring in biochemistry aligns well with pre-med requirements and is useful in the biomaterials, cell and tissue engineering area.

Requires approximately an additional **18 credits**.

Biology

<http://guide.wisc.edu/undergraduate/letters-science/integrative-biology/biology-bs/>

Double majoring in biology aligns well with pre-med requirements and is useful in the cell and tissue engineering area.

Requires approximately an additional **13 credits** plus a related research experience or additional lab (2 credits).

Chemistry

<http://guide.wisc.edu/undergraduate/letters-science/chemistry/chemistry-bs/>

Double majoring in chemistry is useful in the biomaterials and tissue engineering area.

Requires approximately an additional **21 credits** plus a related research experience or additional lab (3 credits).

Computer Science

<http://guide.wisc.edu/undergraduate/letters-science/computer-sciences/computer-sciences-bs/>

Double majoring in computer science is useful in the bioinstrumentation (computing) and medical imaging science areas. See more details below related to the certificate with a list of courses that count in both engineering and CS.

Requires approximately an additional **12 credits** assuming overlap for 15 credits of Engineering with CS.

Math Option I and Math Applied Option II

Math Major: <http://guide.wisc.edu/undergraduate/letters-science/mathematics/mathematics-bs/>

Applied Option 2: https://www.math.wisc.edu/wiki/index.php/Option_2_packages

There are two options to pursue a second major in math. The applied option requires fewer credits as it counts math heavy engineering courses toward the degree. Recommend using Math 431 for the BME statistics requirement and Math major.

Requires approximately an additional **18 credits**: Option I

Requires approximately an additional **12 credits**: Option II – Math advisors can customize a sequence based on BME tracks.

Neurobiology

<http://guide.wisc.edu/undergraduate/letters-science/integrative-biology/neurobiology-bs/>

Double majoring in neurobiology aligns well with pre-med requirements and is useful in the bioinstrumentation and biomaterials and tissue engineering areas.

Requires approximately an additional **10 credits** plus a related research experience or additional lab (2 credits).

Certificates

For a complete list of certificates (minors) offered by UW-Madison visit <http://www.wisc.edu/academics/majors.php>. The following list consists of common certificates earned by BME students.

Biology in Engineering Certificate

<https://www.engr.wisc.edu/academics/undergraduate-academics/biology-in-engineering-certificate/>

The Biology in Engineering Certificate, is designed for engineering students who want to strengthen their biology backgrounds. It is offered especially to encourage engineering students in traditional disciplines to prepare themselves to understand the special engineering problems in biology and medicine. BME students can earn this certificate by taking either seminar BME 515: Therapeutic Medical Devices or BME 517: Biology in Engineering Seminar. Total: 15 credits.

Certificate in Business (for Non-Business Majors)

<http://bus.wisc.edu/bba/academics-and-programs/majors/certificate-business>

The Certificate in Business is designed for students who wish to earn a concentration in a clearly defined academic program in business. Students develop a foundational understanding of business that they can then apply to a specific field. The program consists of six courses for a total of 18 credits. A separate application is required.

Total: 18 credits. Requires approximately an additional **9 credits**, use 9 credits of liberal studies (social sciences) to complete the certificate.

Certificate in Entrepreneurship

<http://bus.wisc.edu/bba/academics-and-programs/majors/certificate-entrepreneurship>

This certificate program offers a distinct bundle of courses that span business entrepreneurship courses and the curricula of several colleges and schools at UW–Madison. Entrepreneurship in this context refers to the process of imagining opportunities and taking action to create value through new ventures.

Total: 15 credits. Requires approximately an additional **6 credits**, use 3-6 credits of liberal studies and 3-6 credits engineering to complete the certificate.

Certificate in Integrated Studies in Science, Engineering and Society

<http://sts.wisc.edu/academics/undergraduate-certificate/about-the-undergraduate-certificate-program/>

The Certificate in Integrated Studies in Science, Engineering and Society (ISSuES) is designed to provide students outside of the College of Letters and Sciences coherent exposure to the social sciences and humanities with an emphasis on the relationship between science, technology, engineering, and society. Students will be required to take a variety of courses that relate to and build on each other and relate to a theme. Focus areas include: design, ethics, general, or leadership.

Total: 15 credits. Requires approximately an additional **0 credits**, use all 15 credits of the liberal studies.

Certificate in International Engineering

<https://www.engr.wisc.edu/academics/undergraduate-academics/certificate-in-international-engineering/>

The Certificate in International Engineering provides recognition for a student's efforts to prepare for an international career by learning about one or more countries other than the United States. For reference, information on Areas Studies Programs at UW-Madison is available here: <http://international.engr.wisc.edu>

Total: 16 credits and an abroad experience. Requires approximately an additional **4 credits**, use liberal studies (including foreign language) and an abroad experience with a primary focus on the language, culture, history, geography, society or institutions of a particular country or region of the world.

Computer Sciences Certificate

<http://guide.wisc.edu/undergraduate/letters-science/computer-sciences/computer-sciences-certificate/>

Courses in CS that are cross-listed with ECE will count toward the 48 engineering credits needed for the degree, as well as in the Bioinstrumentation track and some in the Medical Imaging track. These courses currently include: ECE/CS 252, 320, 352, 354, 435, 506, 532, 533, 539, and 552. ISyE 425, 524

Total: 14-15 credits. Requires approximately an additional **3 credits** (CS 300), it is recommended that students also take CS 400 as one of the course options for an additional 3 credits.

Global Health Certificate

<http://ghi.wisc.edu/undergraduate-certificate/>

The certificate's coursework discusses medicine and particularly the need to improve access to care for all, but it also introduces students to the field of public health, a model for promoting health and well-being that seeks to identify and address the root causes of health problems for populations rather than individuals.

Total: 15 credits and a field experience. Requires approximately an additional **3 credits**, use liberal studies social sciences and humanities credits.

Health and the Humanities Certificate

<https://english.wisc.edu/health-humanities-cert.htm>

The humanities are about the human experience, and this certificate will give you exposure to a range of historical, cultural, and philosophical reasons why people make decisions about their health care. Everyone who comes in contact with the health care system, from health care providers to patients, needs to understand more than just the biological aspects of medicine in order to support health and wellness.

Total: 15 credits. Requires approximately an additional **0 credits**, use all 15 credits of liberal studies including ethnic studies.

Math Certificate

<http://guide.wisc.edu/undergraduate/letters-science/mathematics/mathematics-certificate/>

The primary purpose of the mathematics certificate is to serve those students who wish to enhance their content knowledge in mathematics but are unable to complete the requirements of a second major.

Total: 12 credits. Requires approximately an additional **6 credits**. Recommend using Math 431 for the BME statistics requirement and Math certificate. Recommend using Math 319 and 340 as options.

Physics Certificate

<http://guide.wisc.edu/undergraduate/letters-science/physics/physics-certificate/>

An understanding of the physical universe informs many disciplines. The study of physics is essential to understanding nature and to advancing technology in the coming century. A certificate in physics increases the opportunities for students to become better informed on technological issues at the local, state, national, and international levels.

Total: 18 credits including a research experience. Requires approximately an additional **8 credits**.

Undergraduate Certificate of Excellence in Stem Cell Sciences

<https://stemcells.wisc.edu/node/943>

While this is NOT a degree certificate, The Stem Cell and Regenerative Medicine Center (SCRMC) offers this 'certification' immediately after graduation to undergraduate students who, following an application process, complete a set of course-work and research related to stem-cell sciences.

ORGANIZATIONS & LEADERSHIP

Center for Leadership and Involvement: Campus Orgs

There are over 750 registered student organizations at the UW-Madison. Over 50 of those organizations are recognized as official student organizations within the College of Engineering. For a complete listing of the student organizations registered at the UW-Madison, please visit: <http://www.cfli.wisc.edu> and <https://win.wisc.edu/>

Student Leadership Center: Engineering Orgs

The complete list of Engineering Student Orgs: <https://www.engr.wisc.edu/academics/beyond-the-classroom/>

It is generally recommended to join your Department's organization (BMES) and at least one other student organization. The following are popular among BME students:

Departmental

Biomedical Engineering Society (BMES) <http://bmes.slc.engr.wisc.edu/>

Research specific

Society for Biomaterials (SFB) <https://win.wisc.edu/organization/SFB>

Student Society for Stem Cell Research <https://stemcells.wisc.edu/node/977>

SPIE/OSA (Imaging/Optics) <http://spie.microscopy.wisc.edu/>

International Society for Optics and Photonics / Optical Society of America

Outreach, service and honors

Engineers without Borders <http://ewbuw.org/>

Engineering World Health <http://ewh.slc.engr.wisc.edu/>

Engineering EXPO <http://engineeringexpo.wisc.edu/>

Tau Beta Pi – Honors Society <http://tbp.slc.engr.wisc.edu/>

Wisconsin Engineer Magazine <http://wisconsinengineer.com/>

Affinity

National Society of Black Engineers,
WI Black Engineering Student Society <http://wbess.slc.engr.wisc.edu/>

Society of Hispanic Professional Engineers <http://shpemadison.weebly.com/>

Society of Women Engineers <http://swe.slc.engr.wisc.edu/>

Women in Science and Engineering <http://www.housing.wisc.edu/wise/>

USEFUL ADVISING LINKS

Admissions and Student Services

Engineering Student Services	https://www.engr.wisc.edu/academics/student-services/
How to apply and continue in BME General College Requirement (GCR)	http://engr.wisc.edu/progression
Apply to BME	https://sd3.engr.wisc.edu/tied/
BIOCORE	http://biocore.wisc.edu/

Academic

BME Academics-Undergraduate	https://www.engr.wisc.edu/department/bme/academics/bachelor-of-science-in-biomedical-engineering/
BME Undergraduate Catalog/Guide	http://guide.wisc.edu/undergraduate/engineering/biomedical-engineering/biomedical-engineering-bs/
BME Design	http://bmedesign.engr.wisc.edu/
BME Course descriptions	http://guide.wisc.edu/courses/b_m_e/
Engr Honors in the Liberal Arts (EHLA)	https://www.engr.wisc.edu/academics/undergraduate-academics/honors/
Degree Audit Report System (DARS)	https://dars.services.wisc.edu/dars/request.html
EAGLE bring your DARS to life	https://admin.engr.wisc.edu/eagle/
COE forms and FAQ Part-time permission form Independent learning Tuition Waiver	https://www.engr.wisc.edu/academics/student-services/academic-advising/undergraduate-engineering-students/how-do-i/

Research

Research – Finding a mentor tips	https://biology.wisc.edu/finding-mentor
BME Honors in Research Degree Program	See “BME Academics-Undergraduate” above
BME Research Authorization (BME 399) Only under BME Faculty/Affiliates	https://www.engr.wisc.edu/bme_undergraduate_research_form/ http://directory.engr.wisc.edu/bme/faculty
Undergraduate Research Scholars	http://www.lssaa.wisc.edu/urs/
Hilldale Undergrad Research Fellowship	https://awards.advising.wisc.edu/hilldale-undergraduatefaculty-research-fellowship/

Career

Engineering Career Services	https://ecs.engr.wisc.edu/
American Institute for Medical and Biological Engineering Navigate the Circuit	http://navigate.aimbe.org/
Association for the Advancement of Medical Instrumentation Job Board	http://jobs.aami.org/
IEEE jobs	http://careers.ieee.org/
IEEE EMBS jobs	https://embs-jobs.careerwebsite.com/
Medical Alley – Midwest jobs	https://www.medicalalley.org/
Research Park – Madison biotech	http://universityresearchpark.org/
BioForward Wisconsin	http://www.bioforward.org/
Cell and Cell Therapy Companies	https://biopharmguy.com/links/company-by-name-stem-cells.php
BMES Career Connection	http://jobboard.bmes.org/jobseekers/

Pre-health

Pre-health Advising

<http://www.prehealth.wisc.edu/>

MCAT

<https://www.aamc.org/students/applying/mcat/>

International

Engineering Programs (IESP)

<http://international.engr.wisc.edu/>

UW Study Abroad Programs (IAP)

<https://www.studyabroad.wisc.edu/>

International Internships

<http://internships.international.wisc.edu/>

Financial

Office of Student Financial Aid

<http://finaid.wisc.edu/>

UW and BME Scholarships

<http://scholarships.wisc.edu/>

Tuition and fees

[https://registrar.wisc.edu/tuition & fees.htm](https://registrar.wisc.edu/tuition_&_fees.htm)

Health and Accommodations

University Health Services

<https://www.uhs.wisc.edu/>

McBurney Disability Resource Center

<https://mcburney.wisc.edu/>

Transfer Credits

UW-Transfer Wizard

<http://tis.uwsa.edu/>

Course Equivalency Service (CES)

<http://www.admissions.wisc.edu/ces/>

UW Independent Learning Tuition Waiver

[See "COE Forms and FAQ" above](#)

Graduating?

Apply to graduate in your student center by at least your last semester.

http://registrar.wisc.edu/apply_to_graduate.htm

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BME Faculty List of faculty including research interests and email addresses https://directory.engr.wisc.edu/bme/faculty		