# COMPUTER SCIENCE + BIOENGINEERING, BS

Students in the Computer Science + Bioengineering (CS+BioE) Bachelor of Science degree program will develop an integrative understanding of computational and bioengineering principles in order to analyze biomedical data, construct models of biological systems, and design and implement advanced diagnostic and therapeutic techniques to improve human health. As a joint offering through the Departments of Bioengineering and Computer Science, CS+BioE students will receive a rigorous engineering education that prepares graduates to:

- secure and excel in jobs as engineers in industries of medical imaging, genomics, medical devices, healthcare informatics and software, and drug discovery,
- pursue graduate studies in computer science and bioengineering-related fields, and
- pursue professional degrees in the health sciences, law, and business.

In the first and second years, the curriculum provides students with thorough foundations in scientific computing practices as well as introductory bioengineering concepts. In the third and fourth years, technical and free electives facilitate the study of diverse modern applications of computing in medicine and the life sciences so that students are prepared to address emerging problems throughout their careers.

*for the degree of Bachelor of Science in Computer Science + Bioengineering*

**Graduation Requirements**

Minimum Technical GPA (https://go.grainger.illinois.edu/TechnicalGPA/): 2.0.

TGPA is required for CS, BIOE, and Math courses. See Technical GPA (https://go.grainger.illinois.edu/TechnicalGPA/) to clarify requirements.
**Minimum Overall GPA:** 2.0
**Minimum hours required for graduation:** 128 hours
**General education:** Students must complete the Campus General Education (https://courses.illinois.edu/) requirements including the campus general education language requirement.

**Orientation and Professional Development**

| Code | Title | Hours |
|---|---|---|
| ENG 100 | Grainger Engineering Orientation Seminar (External transfer students take ENG 300.) | 1 |
| BIOE 100 | Bioengineering Seminar | 1 |
| BIOE 120 | Introduction to Bioengineering | 1 |
| Highly recommended, optional 1 credit hour course, CS 100 Freshman Orientation. Credit hour counts toward free electives. | | |
| **Total Hours** | | **3** |

**Foundational Mathematics and Science**

| Code | Title | Hours |
|---|---|---|
| MATH 221 | Calculus I (MATH 220 may be substituted. MATH 220 is appropriate for students with no background in calculus. 4 of 5 credit hours count towards degree.) | 4 |
| MATH 231 | Calculus II | 3 |
| MATH 241 | Calculus III | 4 |
| MATH 257 | Linear Algebra with Computational Applications | 3 |
| or BIOE 210 | Linear Algebra for Biomedical Data Science | |
| MATH 285 | Intro Differential Equations | 3 |
| PHYS 211 | University Physics: Mechanics | 4 |
| PHYS 212 | University Physics: Elec & Mag | 4 |
| Choose one of the following: | | 4 |
| CHEM 102 & CHEM 103 | General Chemistry I and General Chemistry Lab I | |
| OR | | |
| MCB 150 | Molec & Cellular Basis of Life | |
| BIOE 310 | Computational Tools for Biological Data | 3 |
| **Total Hours** | | **32** |

**Computer Science Core**

| Code | Title | Hours |
|---|---|---|
| CS 124 | Introduction to Computer Science I | 3 |
| CS 128 | Introduction to Computer Science II | 3 |
| CS 173 | Discrete Structures | 3 |
| CS 222 | Software Design Lab | 1 |
| CS 225 | Data Structures | 4 |
| Choose one of the following options: | | 8-9 |
| CS 233 & CS 341 | Computer Architecture and System Programming | |
| OR | | |
| CS 340 | Introduction to Computer Systems | |
| & Two CS 400-level courses | Any two (2) 400-level CS courses above CS 403, excluding CS 491 and distinct from any 400-level courses taken to satisfy other requirements. If either or both of the courses are chosen for 4 credits, the extra credit hours will count towards free electives. | |
| CS 374 | Introduction to Algorithms & Models of Computation | 4 |
| CS 357 | Numerical Methods I | 3 |
| or CS 421 | Programming Languages & Compilers | |
| CS Technical Elective | Any 400-level CS course above CS 403, excluding CS 491 and distinct from any 400-level courses taken to satisfy other requirements. | 3 |
| **Total Hours** | | **32-33** |

**Bioengineering Core**

| Code | Title | Hours |
|---|---|---|
| BIOE 205 | Signals & Systems in Bioengrg | 3 |
| BIOE 206 | Cellular Bioengineering | 3 |

| | | |
|---|---|---|
| or BIOE 302 | Modeling Human Physiology | |
| BIOE 404 | CS+BIOE Senior Design (CS + BIOE Senior Design) | 4 |
| **Total Hours** | | **10** |

**Bioengineering Technical Electives**

| Code | Title | Hours |
|---|---|---|
| **Select 15 hours of technical elective credit from the below list:** | | **15** |
| BIOE 303 | Quantitative Physiology Lab | 2 |
| BIOE 360 | Transport & Flow in Bioengrg | 3 |
| BIOE 414 | Biomedical Instrumentation | 3 |
| BIOE 415 | Biomedical Instrumentation Lab | 2 |
| BIOE 430 | Intro Synthetic Biology | 3 or 4 |
| BIOE 461 | Cellular Biomechanics | 4 |
| BIOE 467 | Biophotonics | 3 |
| BIOE 476 | Tissue Engineering | 3 |
| BIOE 479 | Cancer Nanotechnology | 3 |
| BIOE 483 | Biomedical Computed Imaging Systems | 3 or 4 |
| BIOE 484 | Statistical Analysis of Biomedical Images | 3 or 4 |
| BIOE 485 | Computational Mathematics for Machine Learning and Imaging | 4 |
| BIOE 486 | Applied Deep Learning for Biomedical Imaging | 3 or 4 |
| BIOE 487 | Stem Cell Bioengineering | 3 or 4 |
| BIOE 488 | Applied High-Performance Computing for Imaging Science | 3 |
| BIOE 489 | Regulations, Ethics and Logistics in Biomedical Applications of Machine Learning | 3 or 4 |
| BIOE 498 | Special Topics (courses as approved by the department) | 1 to 4 |

**Upper Division Technical Electives**

| Code | Title | Hours |
|---|---|---|
| Students should select 6 hours of 300-400 level general technical elective coursework from the following rubrics: AE, ABE, BIOE, CHBE, CHEM, CS, CEE, ECE, IE, MCB, MATH, ME, NE, NEUR, NPRE, PHYS, SE, STAT, and TAM. | | 6 |
| **Total Hours** | | **6** |

**Free Electives**

| Code | Title | Hours |
|---|---|---|
| Additional coursework, subject to the Grainger College of Engineering restrictions to Free Electives, so that there are at least 128 credit hours earned toward the degree. (https://go.grainger.illinois.edu/FreeElectives/) | | 13-14 |
| **Total Minimum Hours of Curriculum to Graduate** | | **128** |

*for the degree of Bachelor of Science in Computer Science + Bioengineering*

**Sample Sequence**

*This sample sequence is intended to be used only as a guide for degree completion. All students should work individually with their academic advisors to decide the actual course selection and sequence that works best for them based on their academic preparation and goals. Enrichment programming such as study abroad, minors, internships, and so on may impact the structure of this four-year plan. Course availability is not guaranteed during the semester indicated in the sample sequence.*

*Students must fulfill their Language Other Than English requirement by successfully completing a third level of a language other than English. For more information see the corresponding section on the* Degree and General Education Requirements page *(*http://catalog.illinois.edu/general-information/degree-general-education-requirements/*).*

*Free Electives: Additional course work, subject to the Grainger College of Engineering restrictions to Free Electives, so that there are at least 128 credit hours earned toward the degree.*

**First Year**

| First Semester | Hours | | Second Semester | Hours |
|---|---|---|---|---|
| ENG 100 | | 1 | MATH 231 | 3 |
| BIOE 100 | | 1 | BIOE 120 | 1 |
| MATH 221 (MATH 220 may be substituted) | | 4 | PHYS 211 | 4 |
| CS 124 | | 3 | CS 128 | 3 |
| Composition I or General Education (choose a Humanities or Social/Behavioral Science course with Cultural Studies designation) | | 4-3 | CS 173 | 3 |
| CHEM 102 (& CHEM 103) or (MCB 150) | | 3 | General Education choose a Humanities or Social/Behavioral Science course with Cultural Studies designation or Composition I | 3-4 |
| | | **16** | | **17** |

**Second Year**

| First Semester | Hours | | Second Semester | Hours |
|---|---|---|---|---|
| MATH 241 | | 4 | MATH 285 | 3 |
| PHYS 212 | | 4 | MATH 257 or BIOE 210 | 3 |
| CS 222 | | 1 | CS 233 or 340 | 4-3 |
| CS 225 | | 4 | BIOE 205 | 3 |

| | | | |
|---|---|---|---|
| General Education course (choose a Humanities or Social/Behavioral Science course with Cultural Studies designation) | 3 | General Education course (choose a Humanities or Social/Behavioral Science course with Cultural Studies designation) | 3 |
| | **16** | | **16** |

**Third Year**

| First Semester | Hours | Second Semester | Hours |
|---|---|---|---|
| CS 341 (or CS Technical Elective course) | 4 | CS 374 | 4 |
| BIOE 206 | 3 | BIOE 310 | 3 |
| BIOE Technical Elective course | 3 | BIOE Technical Elective course | 3 |
| Free elective course | 2-4 | CS Technical Elective course | 3 |
| Language Other Than English (3rd level) course | 4 | Upper Division Technical Elective course | 3 |
| | **16** | | **16** |

**Fourth Year**

| First Semester | Hours | Second Semester | Hours |
|---|---|---|---|
| CS 357 or 421 | 3 | BIOE 404 (or General Education course choose a Humanities or Social/Behavioral Science course that is also Advanced Composition) | 4-3 |
| BIOE Technical Elective course | 3 | BIOE Technical Elective course | 3 |
| BIOE Technical Elective course | 3 | Upper Division Technical Elective course | 3 |
| Free elective course | 3 | Free elective course or CS Technical Elective course | 3-4 |
| General Education course (choose a Humanities or Social/Behavioral Science course that is also Advanced Composition) or BIOE 404 | 3-4 | Free elective course | 3 |
| | **15** | | **16** |

**Total Hours 128**

*for the degree of Bachelor of Science in Computer Science + Bioengineering*

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The Computer Science + Bioengineering Program prepares graduates to achieve the following seven outcomes by the time of graduation:

1. An ability to identify, formulate, and solve complex computational bioengineering problems by applying principles of engineering, science, and mathematics.

2. An ability to apply engineering design to produce computational solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

3. An ability to communicate effectively with a range of audiences.

4. An ability to recognize ethical and professional responsibilities in computational bioengineering situations and make informed judgments, which must consider the impact of computational bioengineering solutions in global, economic, environmental, and societal contexts.

5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

6. An ability to develop and conduct appropriate experimentation, analysis and interpretation of data, and to use engineering judgment to draw conclusions.

7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

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**B.S. in CS + BIOE**

Bioengineering Faculty (https://bioengineering.illinois.edu/people/faculty/)

The Grainger College of Engineering Admissions (https://grainger.illinois.edu/admissions/)
The Grainger College of Engineering (https://grainger.illinois.edu/)