

BIOENGINEERING (BS)



This program was approved for students entering the university in the Summer 2023–Spring 2024 catalog year. For more information about catalog year, go to Catalog Year Information (<http://catalog.louisville.edu/undergraduate/university-wide-unit-specific-policies/catalog-year/>).

Bachelor of Science in Bioengineering

Unit: Speed School of Engineering (<http://engineering.louisville.edu/>) (SS)

Department: Bioengineering (<https://engineering.louisville.edu/bioengineering/>)

Academic Plan Code(s): BE_ _BBE

Program Information

Bioengineering is a relatively new engineering discipline when compared to the long-standing traditions of other fields of engineering. A bioengineer uses traditional engineering skills and tools to analyze and solve problems in biology and medicine. Bioengineers interact with biologists, biochemists, physicians, physiologists, and therapists to design, develop and manufacture instruments, devices, and software, or to develop new procedures to solve clinical problems.

The Bachelor of Science in Bioengineering degree is designed to provide students with a rigorous education grounded in basic mathematics and sciences traditional to all engineering programs, but focuses additionally on chemistry, biology and physiology, and the opportunity to gain practical experience within the biomedical or bioengineering industry. In the early part of their academic program, students are exposed to fundamentals of engineering and design in mechanical and electrical engineering before proceeding to core Bioengineering classes.

The Bachelor of Science in Bioengineering degree program is accredited by the Engineering Accreditation Commission (EAC) of ABET, www.abet.org (<http://www.abet.org>). The Master of Engineering in Bioengineering degree program is accredited by the Engineering Accreditation Commission (EAC) of ABET, www.abet.org (<http://www.abet.org>).

Degree Summary

| Code | Title | Hours |
|------|---|-------|
| | General Education Requirements (http://catalog.louisville.edu/undergraduate/general-education-requirements/) ¹ | 31 |
| | (19 hours of General Education requirements may be satisfied through coursework required by the degree program) | |
| | College/School Requirements ¹ | 35 |
| | Program/Major Requirements | 53 |

| | |
|----------------------------|------------|
| Supporting Courses | 28 |
| Minimum Total Hours | 128 |

¹ Some courses required in this degree program satisfy multiple requirements. To complete the degree in the minimum number of hours listed, some hours from the General Education Requirements must be satisfied by courses defined by the unit and/or program. Using other courses to satisfy General Education requirements will require additional hours to complete the degree requirements. See the Degree Requirements and/or Track tabs for specific coursework.

Specific coursework information can be found on the Degree Requirements tab.

Incoming Student Admission Criteria

High School Curriculum Requirements: All schools require graduation from an accredited high school and completion of the Kentucky Pre-College Curriculum requirements. In addition, Speed School requires successful completion of the following courses in high school:

- Calculus or pre-calculus
- Chemistry

Students with ACT / SAT Scores

- ACT composite and math scores of 25 OR SAT combined CR+M score of 1200 and math score of 590. A 3.0 GPA on a 4.0 scale

OR

- ACT composite and math scores of 24 OR SAT combined CR+M score of 1160 and math score of 570. A 3.5 GPA on a 4.0 scale

Students without ACT / SAT Scores

- HS GPA of 3.0 (or better) on a 4.0 scale
- Comprehensive transcript evaluation
- Review of Student Resume

Transferring to Engineering BS degree programs

Students with 24 hours or more transferable semester hours will have a minimum college grade point average of 2.8 and at least B-minus grades in each of the following courses: ENGR 181 (or equivalent) and Intro to Chemistry (CHEM 101 or equivalent).

It is recommended students successfully complete Physics I (PHYS 298 or equivalent) before transferring to the J.B. Speed School of Engineering.

General Education Requirements

| Code | Title | Hours |
|--|--|-------|
| | General Education Requirements (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | 31 |
| The following courses are required by the program and satisfy the respective General Education Requirement(s): | | |

| | |
|-------------|---|
| CHEM 201 | General Chemistry I - S (http://catalog.louisville.edu/undergraduate/general-education-requirements/) |
| CHEM 207 | Introduction to Chemical Analysis I - SL (http://catalog.louisville.edu/undergraduate/general-education-requirements/) |
| COMM 111 | Introduction to Public Speaking - OC (http://catalog.louisville.edu/undergraduate/general-education-requirements/) |
| or COMM 112 | Business and Professional Speaking - OC (http://catalog.louisville.edu/undergraduate/general-education-requirements/) |
| ENGL 101 | Introduction to College Writing - WC (http://catalog.louisville.edu/undergraduate/general-education-requirements/) |
| ENGL 102 | Intermediate College Writing - WC (http://catalog.louisville.edu/undergraduate/general-education-requirements/) |
| ENGR 101 | Engineering Analysis I - QR (http://catalog.louisville.edu/undergraduate/general-education-requirements/) |
| PHYS 298 | Introductory Mechanics, Heat and Sound - S (http://catalog.louisville.edu/undergraduate/general-education-requirements/) ¹ |

All degrees require the completion of the University-wide General Education Program (link provided above). To complete the degree in the **minimum number of hours** listed on the Overview tab, some hours from the General Education Requirements must be satisfied by courses defined by the unit and/or program.

College/School Requirements

| Code | Title | Hours |
|---|---|-------|
| Speed School Core ¹ | | |
| CHEM 201 | General Chemistry I - S (http://catalog.louisville.edu/undergraduate/general-education-requirements/) ¹ | 3 |
| CHEM 207 | Introduction to Chemical Analysis I - SL (http://catalog.louisville.edu/undergraduate/general-education-requirements/) ¹ | 1 |
| Select one of the following: ¹ | | 3 |
| COMM 111 | Introduction to Public Speaking - OC (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | |
| COMM 112 | Business and Professional Speaking - OC (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | |
| ENGL 101 | Introduction to College Writing - WC (http://catalog.louisville.edu/undergraduate/general-education-requirements/) ^{1,2} | 3 |
| ENGL 102 | Intermediate College Writing - WC (http://catalog.louisville.edu/undergraduate/general-education-requirements/) ^{1,2} | 3 |
| ENGR 101 | Engineering Analysis I - QR (http://catalog.louisville.edu/undergraduate/general-education-requirements/) ¹ | 4 |
| ENGR 102 | Engineering Analysis II | 4 |
| ENGR 110 | Engineering Methods, Tools, and Practice I | 2 |

| | | |
|----------|---|---|
| ENGR 111 | Engineering Methods, Tools and Practice II | 2 |
| ENGR 201 | Engineering Analysis III | 4 |
| ENGR 205 | Differential Equations for Engineering | 2 |
| PHYS 298 | Introductory Mechanics, Heat and Sound - S (http://catalog.louisville.edu/undergraduate/general-education-requirements/) ¹ | 4 |

Minimum Total Hours **35**

Program/Major Requirements

| Code | Title | Hours |
|---|--|-------|
| Bioengineering Department ^{3,4} | | |
| BE 101 | Introduction to Bioengineering | 1 |
| BE 288 | Bioengineering Co-op Education Seminar | 0 |
| BE 289 | Bioengineering Co-op Education I | 1 |
| BE 310 | Biotransport Phenomena | 3 |
| BE 322 | Circuits and Devices for Bioengineers | 3 |
| BE 340 | Computational Methodologies in Bioengineering | 3 |
| BE 354 | Anatomy and Physiology | 3 |
| BE 359 | Cell and Molecular Biology for Bioengineers | 3 |
| BE 360 | Biomechanics Principles | 3 |
| BE 389 | Bioengineering Co-op Education II | 1 |
| BE 420 | Biosystems & Signals | 3 |
| BE 423 | Bioengineering Measurements Laboratory | 2 |
| BE 430 | Biosystems Controls | 3 |
| BE 450 | Biomaterials & Biocompatibility | 3 |
| BE 489 | Bioengineering Co-op Education III | 1 |
| BE 491 | Capstone A | 3 |
| BE 497 | Capstone B - CUE (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | 3 |
| Bioengineering Electives (select 9 credit hours from the following): ⁴ | | 9 |
| BE 453 | Introduction to Molecular Bioengineering | |
| BE 460 | Biomechanics of Tissues and Organs | |
| BE 480 | Biomedical Device Design | |
| BE 500 | Special Topics in Bioengineering | |
| BE 522 | Biomedical Acoustics | |
| BE 524 | LabVIEW for Bioengineers | |
| BE 530 | Machine Learning in Python | |
| BE 540 | Machine Learning in Medicine | |
| BE 542 | Medical Image Computing | |
| BE 544 | Artificial Intelligence Techniques in Digital Pathology | |
| BE 552 | Introduction to Tissue Engineering | |
| BE 553 | Nanoscale Bioengineering: Application and Methodology of Nanobiomaterials in Bioengineering | |
| BE 581 | Advanced Computer-Aided Design and Manufacturing for Bioengineers | |
| BE 593 | Independent Study in Bioengineering | |
| BIOC 545 | Biochemistry I | |
| BIOC 547 | Advanced Biochemistry II | |
| BIOC 645 | Advanced Biochemistry I | |
| BIOC 647 | Advanced Biochemistry II | |
| CHEM 545 | Biochemistry I | |

| | |
|----------|--|
| CHEM 547 | Biochemistry II |
| CHEM 645 | Advanced Biochemistry I |
| CHEM 647 | Advanced Biochemistry II |
| IE 430 | Quality Control |
| IE 482 | Quality of Care and Patient Safety |
| IE 484 | Health IT and Clinician Support |
| IE 580 | Introduction to Human Factors Engineering and Ergonomics |
| ME 422 | Machine Design I |

Bioengineering Core

| | | |
|----------|---|---|
| CHEM 202 | General Chemistry II - S (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | 3 |
| CHEM 208 | Introduction to Chemical Analysis II - SL (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | 1 |
| CHEM 209 | Introduction to Chemical Analysis III | 1 |

Minimum Total Hours **53**

| Code | Title | Hours |
|----------------------------|--|-----------|
| Supporting Courses | | |
| BIOL 240 | Unity of Life - S (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | 3 |
| CEE 205 | Mechanics I: Statics | 3 |
| CHEM 341 | Organic Chemistry I | 3 |
| CHEM 343 | Organic Chemistry Laboratory I | 2 |
| IE 360 | Probability and Statistics for Engineers | 3 |
| ME 206 | Mechanics II: Dynamics | 3 |
| ME 251 | Thermodynamics I | 3 |
| PHYS 295 | Introductory Laboratories I - SL (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | 1 |
| PHYS 299 | Introductory Electricity, Magnetism and Light | 4 |
| ENGR 151 | Engineering Graphics Technology | 1 |
| ENGR 330 | Linear Algebra for Engineering | 2 |
| Minimum Total Hours | | 28 |

Candidates for the Bachelor of Science degree must be in Good Standing (university GPA ≥ 2.25) and must attain a grade point average of at least 2.25 for all courses used to satisfy degree requirements.

| Code | Title | Hours |
|--|--|-------|
| Culminating Undergraduate Experience (Graduation requirement) | | |
| Requirement fulfilled by completing: | | |
| BE 497 | Capstone B - CUE (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | |

¹ This course is a General Education requirement for the program; see louisville.edu/provost/ger/ (<http://www.louisville.edu/provost/ger/>) for the listing, by academic year, of AH/D1/D2/SB/SBH Electives which satisfy the University-wide General Education requirements. Note that the 12-hour total for the AH/D1/D2/SB/SBH electives assumes the use of double counting of D1/D2 with another category.

² Students completing ENGL 105 in lieu of ENGL 101 or ENGL 102 satisfy the General Education and Engineering Fundamentals requirements for Written Communication. However, an additional 3-hr Writing (WR)

course or honors Written Communication (WC) course may be needed to satisfy program credit hour requirements.

- ³ A student is allowed to accumulate no more than two D+ or lower grades in BE prefixed courses (including BE approved elective courses) to graduate with a baccalaureate degree. If a student accumulates any D+ or lower grade, it is strongly recommended that the course be repeated to earn a better grade before proceeding to the next course in the sequence. If a student accumulates a third D+ or lower grade, the student is required to repeat the course to earn a better grade.

- ⁴ A maximum of one non-BE course can be taken as an elective. Students must meet all course prerequisites. The courses chosen to fulfill this elective requirement cannot be used to satisfy any other program or degree requirements.

Flight Plan

| Year 1 | | |
|--|--|-----------|
| Fall | | Hours |
| CHEM 201 | General Chemistry I - S (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | 3 |
| CHEM 207 | Introduction to Chemical Analysis I - SL (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | 1 |
| CHEM 208 | Introduction to Chemical Analysis II - SL (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | 1 |
| ENGL 101 | Introduction to College Writing - WC (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | 3 |
| ENGR 101 | Engineering Analysis I - QR (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | 4 |
| ENGR 110 | Engineering Methods, Tools, and Practice I | 2 |
| General Education: Cardinal Core Arts & Humanities, Social & Behavioral Sciences, or Social & Behavioral Sciences Historical Perspective US Diversity - AHD1, SBD1, or SBHD1 | | 3 |
| Hours | | 17 |
| Spring | | |
| BE 101 | Introduction to Bioengineering | 1 |
| CHEM 202 | General Chemistry II - S (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | 3 |
| CHEM 209 | Introduction to Chemical Analysis III | 1 |
| ENGL 102 | Intermediate College Writing - WC (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | 3 |
| ENGR 102 | Engineering Analysis II | 4 |
| ENGR 111 | Engineering Methods, Tools and Practice II | 2 |
| PHYS 298 | Introductory Mechanics, Heat and Sound - S (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | 4 |
| Hours | | 18 |
| Summer | | |
| CEE 205 | Mechanics I: Statics | 3 |
| ENGR 151 | Engineering Graphics Technology | 1 |
| ENGR 201 | Engineering Analysis III | 4 |
| PHYS 295 | Introductory Laboratories I - SL (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | 1 |
| General Education: Cardinal Core Arts & Humanities, Social & Behavioral Sciences, or Social & Behavioral Sciences Historical Perspective - AH, SB, or SBH | | 3 |
| Hours | | 12 |
| Year 2 | | |
| Fall | | |
| BIOL 240 | Unity of Life - S (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | 3 |

| | | |
|---|---|------------|
| CHEM 341 | Organic Chemistry I | 3 |
| ENGR 205 | Differential Equations for Engineering | 2 |
| ME 206 | Mechanics II: Dynamics | 3 |
| ME 251 | Thermodynamics I | 3 |
| PHYS 299 | Introductory Electricity, Magnetism and Light | 4 |
| Hours | | 18 |
| Spring | | |
| BE 288 | Bioengineering Co-op Education Seminar | 0 |
| BE 310 | Biotransport Phenomena | 3 |
| BE 354 | Anatomy and Physiology | 3 |
| BE 359 | Cell and Molecular Biology for Bioengineers | 3 |
| BE 360 | Biomechanics Principles | 3 |
| General Education: Cardinal Core Arts & Humanities, Social & Behavioral Sciences, or Social & Behavioral Sciences Historical Perspective - AH, SB, or SBH | | 3 |
| Hours | | 15 |
| Summer | | |
| BE 322 | Circuits and Devices for Bioengineers | 3 |
| BE 340 | Computational Methodologies in Bioengineering | 3 |
| BE 450 | Biomaterials & Biocompatibility | 3 |
| Select one of the following: | | 3 |
| COMM 111 | Introduction to Public Speaking - OC (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | |
| COMM 112 | Business and Professional Speaking - OC (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | |
| Hours | | 12 |
| Year 3 | | |
| Fall | | |
| BE 289 | Bioengineering Co-op Education I | 1 |
| Hours | | 1 |
| Spring | | |
| BE 420 | Biosystems & Signals | 3 |
| BE 423 | Bioengineering Measurements Laboratory | 2 |
| Bioengineering Elective I | | 3 |
| CHEM 343 | Organic Chemistry Laboratory I | 2 |
| ENGR 330 | Linear Algebra for Engineering | 2 |
| IE 360 | Probability and Statistics for Engineers | 3 |
| General Education: Cardinal Core Arts & Humanities, Social & Behavioral Sciences, or Social & Behavioral Sciences Historical Perspective - AH, SB, or SBH | | 3 |
| Hours | | 18 |
| Summer | | |
| BE 389 | Bioengineering Co-op Education II | 1 |
| Hours | | 1 |
| Year 4 | | |
| Fall | | |
| BE 430 | Biosystems Controls | 3 |
| BE 491 | Capstone A | 3 |
| BE 497 | Capstone B - CUE (http://catalog.louisville.edu/undergraduate/general-education-requirements/) | 3 |
| Bioengineering Elective II | | 3 |
| Bioengineering Elective III | | 3 |
| Hours | | 15 |
| Spring | | |
| BE 489 | Bioengineering Co-op Education III | 1 |
| Hours | | 1 |
| Minimum Total Hours | | 128 |

Degree Audit Report

Degree Audit reports illustrate how your completed courses fulfill the requirements of your academic plan. What-if reports allow you to

compare the courses you have completed in your current academic plan to the courses required in another academic plan. Should you have questions about either report, please consult with your academic advisor.

Flight Planner

The Flight Planner tool is available for you to create a personalized Flight Plan to graduation. Advisors have access to review your Flight Planner and can help you adjust it to ensure you remain on track to graduate in a timely manner.

To create these reports:

- Log into your ULink account.
- Click on the Academic Progress tile.
- Select the appropriate report.
 - To run a Degree Audit report, click on "View my Degree Audit."
 - To create a What-if report, click on "Create a What-if Advisement Report."
 - To run a Flight Planner report, click on "Use My Flight Planner."

Click here to run a Degree Audit report, create a What-if report, or run a Flight Planner report. (<https://ulink.louisville.edu>)

The Bachelor of Science in Bioengineering (BE BBE) program prepares students to meet the requirements for certification and/or licensure. If you plan to pursue professional licensure or certification you should first determine your state's criteria for examination and licensure to see how/if our program meets those requirements prior to enrollment. We recommend that you also contact your state's licensing board directly to verify that the requirements have not changed recently and to answer any questions especially those regarding additional requirements beyond the degree.

More information about certification or licensure is available at the following website: <https://louisville.edu/oapa/licensure-information> (<https://louisville.edu/oapa/licensure-information/>) (you may search by school or by the name of the program then click on 'View Details' to display the information).

For programs with an online option, more information about certification or licensure is available here: <https://louisville.edu/online/About-Us?tab=disclosures> (<https://louisville.edu/online/About-Us/?tab=disclosures>).