Biological Engineering Option

Students may enhance their academic preparation for the growing opportunities in the biological-related industries by adding the biological engineering option to the standard chemical engineering program. In addition to the elective choices listed in Table II below, students may replace BBMB 301 with BBMB 404 and BBMB 405 or Biol 313 and Biol 314. BBMB 405 or Biol 314 can be used to meet Chemistry or Professional Elective requirements. ChE 426 may be replaced with ChE 427.

Table II – Electives for Biological Engineering Option

<table>
<thead>
<tr>
<th>Social Science &amp; Humanities electives: (see page 10)</th>
<th>MINIMUM CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Electives</td>
<td>15</td>
</tr>
<tr>
<td>Communications electives: Engl 309, Engl 312, Engl 314, or JI MC 347</td>
<td>3</td>
</tr>
<tr>
<td>Advanced Chemistry electives: BBMB 405, 411, 420, 451, Biol 314</td>
<td>3</td>
</tr>
<tr>
<td>Statistics electives: Stat 305, 231, 341, 342, 401, 495, 496</td>
<td>3</td>
</tr>
<tr>
<td>Chemical Engineering electives: ChE 415, 440, 542, 562</td>
<td>3</td>
</tr>
<tr>
<td>Engineering electives: BioE (Approved), BRT 501, C E 421</td>
<td>3</td>
</tr>
<tr>
<td>Professional electives: ChE 415, 440, 542, 562, 490, AND one APPROVED course from: 300+ Life Science, Chem, FS HN, or BBMB (not BBMB 301)</td>
<td>6</td>
</tr>
</tbody>
</table>

Course descriptions may be found in the current ISU Catalog, which is available in hardcopy from the bookstores or online at: [http://www.iastate.edu/~catalog/](http://www.iastate.edu/~catalog/).

Suggested Emphases for Technical Electives (prerequisites & *co-requisites)

Listed below are courses that students may consider taking as part of their package of electives for various career paths. These lists are not exhaustive, and sometimes more courses are suggested than a student has time to take. All students should work closely with their faculty advisor to choose an appropriate set of electives to suit their individual career goals.

General Graduate School Preparation

ChE/Professional Electives
- ChE 408 (3) Surface and Colloid Chemistry (ChE 381)
- ChE 490 (variable) Independent Study
- ChE 545 (3) Analytical and Numerical Methods (ChE 358 and Math 267)
- ChE 500-level courses

Professional Electives
- Math 307 (3) Matrices and Linear Algebra (2 semesters of calculus)
- Math 385 (3) Introduction to Partial Differential Equations (Math 265 and Math 267)

Statistics Elective
- Stat 305 (3) Engineering Statistics (Math 165)

Chemistry/Professional Electives
- Chem 324 (3) Introductory Quantum Mechanics (Chem 178, Math 166, Phys 222)
General Industrial Preparation

ChE/Professional Electives
- ChE 406 (3) Environmental Chemodynamics (ChE 381 and *ChE 358)
- ChE 408 (3) Surface and Colloid Chemistry (ChE 381)
- ChE 415 (3) Biochemical Engineering (ChE 357, ChE 382, and Chem 331)
- ChE 545 (3) Analytical and Numerical Methods (ChE 358 and Math 267)

Engineering/Professional Electives
- IE 305 (3) Engineering Economic Analysis (Math 166)

Statistics Elective
- Stat 305 (3) Engineering Statistics (Math 165)

Biochemical Engineering

ChE/Professional Electives
- ChE 415 (3) Biochemical Engineering (ChE 357, ChE 382, and Chem 331)
- ChE 562 (3) Bioseparations (ChE 357)

Chemistry/Professional Electives
- Biol 313 (3) Principles of Genetics (Biol 211, 211L, 212, 212L)
- BBMB 404 (3) Biochemistry I (Chem 332)
- BBMB 405 (3) Biochemistry II (BBMB 404)

Engineering/Professional Electives
- CE 421 (3) Environmental Biotechnology (CE 326)

Professional Elective
- Micro 201 (2) General Microbiology (one semester of biology)
- BioE 411 (3) Bioprocessing and Bioproducts (AE 216, Math 165, Chem 177, Biol 173 or 211 or higher, or BRT 501, senior or graduate classification)

Biomedical Engineering

ChE/Professional Electives
- ChE 415 (3) Biochemical Engineering (ChE 357, ChE 382, and Chem 331)
- ChE 440 (3) Biomedical Applications of Chemical Engineering (ChE 210, Math 266, and Phys 222)
- ChE 562 (3) Bioseparations (ChE 357)

Professional Elective
- Biol 335 (5) Plants and People (Biol 211 & 211L)
- BioE 341 (3) BioMEMs and Nanotechnology (BioE 202)
- BioE 352 (3) Molecular, Cellular, and Tissue Biomechanics (BioE 201, EM 324, MatE 272)
- BioE 450 (3) Biosensing (BioE 202)

Chemistry/Professional Electives
- Biol 313 (3) Principles of Genetics (Biol 211, 211L, 212, 212L)
- Biol 314 (3) Principles of Molecular Cell Biology (Biol 313)
- BBMB 404 (3) Biochemistry I (Chem 332)
- BBMB 405 (3) Biochemistry II (BBMB 404)

Environmental Science and Engineering

ChE/Professional Electives
- ChE 406 (3) Environmental Chemodynamics (ChE 381 and *ChE 358)
- ChE 408 (3) Surface and Colloid Chemistry (ChE 381)
- ChE 415 (3) Biochemical Engineering (ChE 357, ChE 382, and Chem 331)

Engineering/Professional Electives
- CE 326 (3) Principles of Environmental Engineering (Chem 178, Math 166, and *EM 378)
- CE 420 (3) Environmental Engineering Chemistry (CE 326, Chem 177, Chem 178, and Math 166)
- CE 421 (3) Environmental Biotechnology (CE 326)
- CE 428 (3) Water and Wastewater Treatment Plant Design (CE 326)
- CE 529 (3) Hazardous Waste Management (CE 326)

Professional Electives
- EnvS 324 (3) Energy and the Environment
- Geol 434 (3) Contaminant Hydrogeology (Geol 411 or equivalent)
- Mteor 404 (3) Global Change (four courses in physical or biological sciences or engr., Jr classification)

Statistics Elective
- Stat 305 (3) Engineering Statistics (Math 165)
**Food Engineering**

Chemistry/Professional Electives
- Biol 313 (3) Principles of Genetics (Biol 211, 211L, 212, 212L)
- FSHN 311 (3) Food Chemistry (FSHN 203, TSM 115, Chem 331 & 331L, and *BBMB 301)

Engineering/Professional Electives
- A E 451 (3) Food and Bioprocess Engineering (ChE 357 or FSHN 351 and Math 267)

ChE/Professional Electives
- ChE 408 (3) Surface and Colloid Chemistry (ChE 381)
- ChE 415 (3) Biochemical Engineering (ChE 357, ChE 382, and Chem 331)

Professional Electives
- FSHN 412 (4) Food Product Development (FSHN 311 or 411 and FSHN 471)
- FSHN 420 (3) Food Microbiology (Micro 201 or 302)
- FSHN 421 (3) Food Microbiology Laboratory (Micro 201/201L or 302/302L, FSHN 420*, FSHN 203*)
- FSHN 471 (3) Food Processing (Micro 201 or 302)
- FSHN 472 (2) Food Processing Lab (FSHN 351, 471*)

**Materials Science**

ChE/Professional Electives
- ChE 442 (3) Polymers and Polymer Engineering (ChE 382 and Chem 331 or MatE 351)

Chemistry/Professional Electives
- Chem 301 (2) Inorganic Chemistry - non-metals (Chem 324)
- Chem 402 (3) Advanced Inorganic Chemistry - metals (Chem 301, Chem 331 recommended)
- Chem 576 (3) Surface Chemistry (Chem 324)
- MatE 454 (3) Polymer Composites and Processing (MatE 351)

Professional Elective
- Phys 321 (3) Introduction to Modern Physics I (Phys 222 and Math 266*)
- Phys 322 (3) Introduction to Modern Physics II (Phys 321)

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**BioEngineering Minor**

The bioengineering minor at Iowa State University is an interdisciplinary program that complements a student’s major discipline by providing additional insight into the interactions between various engineering disciplines and biological systems, emphasizing new ways of solving biological problems. The program provides students with unique educational experiences to apply engineering skills and create new biobased products and devices.

The program is open to all undergraduate engineering students at Iowa State University. This minor will provide students with a foundation of core Bioengineering knowledge, on which tracks will be superimposed to provide in-depth exposure to targeted areas of specialization. In addition to the core courses—BioE 201 and 202—students will complete coursework identified in the following tracks:

Bioinformatics and Systems Biology: BioE 325, BCB 211, 401, 402, & 442.
Biomaterials and Biomechanics: BioE 352, ChE 440, Ex Sp 355, & MatE 456.