

# Chemical Engineering (BS): Biomolecular Concentration

The Biomolecular Concentration emphasizes hands-on laboratory molecular biology skills that are highly relevant to pharmaceutical, medical, engineering, and agricultural fields. Students completing this concentration also fulfill the requirements for a Minor in Biotechnology.

## Plan Requirements

### First Year

Fall Semester		Hours
CH 101 or CH 103	Chemistry - A Molecular Science <sup>1</sup> or General Chemistry I for Students in Chemical Sciences	3
CH 102 or CH 104	General Chemistry Laboratory <sup>1</sup> or General Chemistry Laboratory I for Students in Chemical Sciences	1
E 101	Introduction to Engineering & Problem Solving <sup>2</sup>	1
E 115	Introduction to Computing Environments	1
MA 141	Calculus I <sup>1</sup>	4
ENG 101	Academic Writing and Research <sup>2</sup>	4
<b>Hours</b>		<b>14</b>

### Spring Semester

CH 201 or CH 203	Chemistry - A Quantitative Science <sup>2</sup> or General Chemistry II for Students in Chemical Sciences	3
CH 202 or CH 204	Quantitative Chemistry Laboratory <sup>2</sup> or General Chemistry Laboratory II for Students in Chemical Sciences	1
MA 241	Calculus II <sup>1</sup>	4
PY 205 & PY 206	Physics for Engineers and Scientists I and Physics for Engineers and Scientists I Laboratory <sup>1</sup>	4
Select one of the following Economics Courses:		3
ARE 201	Introduction to Agricultural & Resource Economics	
ARE 201A	Introduction to Agricultural & Resource Economics	
EC 201	Principles of Microeconomics	
EC 205	Fundamentals of Economics	
E 102	Engineering in the 21st Century	2
<b>Hours</b>		<b>17</b>

### Second Year

Fall Semester		Hours
CH 221 or CH 225	Organic Chemistry I <sup>2</sup> or Organic Chemistry I for Students in Chemical Sciences	3
CH 222 or CH 226	Organic Chemistry I Lab <sup>2</sup> or Organic Chemistry Laboratory I for Students in Chemical Sciences	1
CHE 205	Chemical Process Principles <sup>2</sup>	4

MA 242	Calculus III <sup>2</sup>	4
PY 208 & PY 209	Physics for Engineers and Scientists II and Physics for Engineers and Scientists II Laboratory	4

**Hours 16**

### Spring Semester

CH 223 or CH 227	Organic Chemistry II or Organic Chemistry II for Students in Chemical Sciences	3
CH 224 or CH 228	Organic Chemistry II Lab or Organic Chemistry Laboratory II for Students in Chemical Sciences	1
CHE 225	Introduction to Chemical Engineering Analysis <sup>2</sup>	3
MA 341	Applied Differential Equations I <sup>2</sup>	3
BIO 183	Introductory Biology: Cellular and Molecular Biology	4

**Hours 14**

### Third Year

Fall Semester		Hours
BCH 451	Principles of Biochemistry	4
CHE 311	Transport Processes I <sup>2</sup>	3
CHE 315	Chemical Process Thermodynamics <sup>2</sup>	3
BIT 410	Manipulation of Recombinant DNA	4
CHE 395	Professional Development Seminar	1
<b>Hours</b>		<b>15</b>

### Spring Semester

BIT Laboratory Modules (p. 2)		4
CHE 312	Transport Processes II	3
CHE 316	Thermodynamics of Chemical and Phase Equilibria	3
CHE 330	Chemical Engineering Lab I	4
<b>Hours</b>		<b>14</b>

### Fourth Year

Fall Semester		Hours
CHE 446	Design and Analysis of Chemical Reactors	3
CHE 450	Chemical Engineering Design I	3
Biotech Minor Group E Elective (p. 2)		3
CHE 497	Chemical Engineering Projects I	3
<b>Hours</b>		<b>12</b>

### Spring Semester

CHE 435	Process Systems Analysis and Control	3
CHE 448	Bioreactor Design	2
CHE 451	Chemical Engineering Design II	3
CHE 452	Biomolecular Engineering	2
Technical Elective (p. 2)		2
<b>Hours</b>		<b>12</b>
<b>Total Hours</b>		<b>114</b>

<sup>1</sup> A grade of C or higher is required.

<sup>2</sup> A grade of C- or higher is required.

Code	Title	Hours
<b>GEP Courses</b>		
GEP Humanities ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/</a> )		6
GEP Social Sciences ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/</a> )		3
GEP Health and Exercise Studies ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/</a> )		2
GEP Elective ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/</a> )		3
GEP Global Knowledge ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-global-knowledge/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-global-knowledge/</a> ) (verify requirement)		
GEP Foundations of American Democracy ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-fad/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-fad/</a> ) (verify requirement)		
World Language Proficiency ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/world-language-proficiency/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/world-language-proficiency/</a> ) (verify requirement)		
<b>Total Hours</b>		<b>14</b>

## BIT Lab Modules

Code	Title	Hours
BEC 463/563/ CHE 463/563	Fermentation of Recombinant Microorganisms	2
BIT 462/562		2
BIT 464/564	Protein Purification	2
BIT 465/565	Real-time PCR Techniques	2
BIT 466/566/ PO 466/566	Animal Cell Culture Techniques	2
BIT 467/567	PCR and DNA Fingerprinting	2
BIT 468/568		2
BIT 471/571	RNA Interference and Model Organisms	2
BIT 473/573	Protein Interactions	2
BIT 474/574	Plant Genetic Engineering	2
BIT 476	Applied Bioinformatics	2
BIT 477/577	Metagenomics	2
BIT 478/578		2
BIT 479/579	High-Throughput Discovery	2
BIT 480/580	Yeast Metabolic Engineering	2
BIT/PB 481	Plant Tissue Culture and Transformation	2
BIT 492	External Learning Experience	1-6
BIT 493	Special Problems in Biotechnology	1-6
BIT 495	Special Topics in Biotechnology	1-3
BIT/BIO/CH 572	Proteomics	3

## Biotech Minor Group E Electives

Code	Title	Hours
IDS 201	Environmental Ethics	3
IDS 303	Humans and the Environment	3
NR 303	Humans and the Environment	3
PHI 325	Bio-Medical Ethics	3
STS 302	Contemporary Science, Technology and Human Values	3

STS 304	Ethical Dimensions of Progress	3
STS 325	Bio-Medical Ethics	3

## Technical Electives

Code	Title	Hours
BBS 426/526/ BEC 426/526	Upstream Biomanufacturing Laboratory	2
BEC 330	Principles and Applications of Bioseparations	2
BEC 462/562	Fundamentals of Bio-Nanotechnology	3
BEC 463/563	Fermentation of Recombinant Microorganisms	2
BEC 480/580	cGMP Fermentation Operations	2
BEC 485/585	cGMP Downstream Operations	2
BEC/CHE 488	Animal Cell Culture Engineering	2
BIT 463/563	Fermentation of Recombinant Microorganisms	2
BIT 464/564	Protein Purification	2
BME 466/566	Polymeric Biomaterials Engineering	3
CE 373	Fundamentals of Environmental Engineering	3
CHE 462/562	Fundamentals of Bio-Nanotechnology	3
CHE 463/563	Fermentation of Recombinant Microorganisms	2
ECE 331	Principles of Electrical Engineering	3
FS 426/526	Upstream Biomanufacturing Laboratory	2
MSE 201	Structure and Properties of Engineering Materials	3
NE 419	Introduction to Nuclear Energy	3
PSE 425	Bioenergy & Biomaterials Engineering	3
TE 466/566	Polymeric Biomaterials Engineering	3

## Semester Sequence

This is a sample.

### First Year

Fall Semester	Hours
CH 101 Chemistry - A Molecular Science and General Chemistry Laboratory <sup>1</sup>	4
E 101 Introduction to Engineering & Problem Solving <sup>1</sup>	1
E 115 Introduction to Computing Environments	1
ENG 101 Academic Writing and Research <sup>1</sup>	4
MA 141 Calculus I <sup>1</sup>	4
GEP Health and Exercise Studies ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/</a> )	1

**Hours 15**

### Spring Semester

CH 201 Chemistry - A Quantitative Science and Quantitative Chemistry Laboratory <sup>2</sup>	4
MA 241 Calculus II <sup>1</sup>	4
PY 205 Physics for Engineers and Scientists I and Physics for Engineers and Scientists I Laboratory <sup>1</sup>	4
GEP Health and Exercise Studies ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/</a> )	1

E 102 Engineering in the 21st Century	2
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**Hours 15**

**Second Year****Fall Semester**

CH 221 & CH 222	Organic Chemistry I and Organic Chemistry I Lab	4
CHE 205	Chemical Process Principles <sup>2</sup>	4
MA 242	Calculus III <sup>2</sup>	4
PY 208 & PY 209	Physics for Engineers and Scientists II and Physics for Engineers and Scientists II Laboratory	4
<b>Hours</b>		<b>16</b>

**Spring Semester**

CH 223 & CH 224	Organic Chemistry II and Organic Chemistry II Lab	4
CHE 225	Introduction to Chemical Engineering Analysis <sup>2</sup>	3
MA 341	Applied Differential Equations I <sup>2</sup>	3
BIO 183	Introductory Biology: Cellular and Molecular Biology	4
GEP Requirement ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/</a> )		3
<b>Hours</b>		<b>17</b>

**Third Year****Fall Semester**

BCH 451	Principles of Biochemistry	4
CHE 311	Transport Processes I <sup>2</sup>	3
CHE 315	Chemical Process Thermodynamics <sup>2</sup>	3
CHE 395	Professional Development Seminar	1
CHE 497	Chemical Engineering Projects I	3
BIT 410	Manipulation of Recombinant DNA	4
<b>Hours</b>		<b>18</b>

**Spring Semester**

BIT Lab Modules (p. 2)		4
CHE 312	Transport Processes II	3
CHE 316	Thermodynamics of Chemical and Phase Equilibria	3
CHE 330	Chemical Engineering Lab I	4
GEP Requirement ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/</a> )		3
<b>Hours</b>		<b>17</b>

**Fourth Year****Fall Semester**

CHE 446	Design and Analysis of Chemical Reactors	3
CHE 450	Chemical Engineering Design I	3
GEP Requirement ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/</a> )		3
GEP Requirement ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/</a> )		3
Biotech Minor Group E Elective (p. 2)		3
<b>Hours</b>		<b>15</b>

**Spring Semester**

CHE 435	Process Systems Analysis and Control	3
CHE 451	Chemical Engineering Design II	3
CHE 452	Biomolecular Engineering	2
CHE 448	Bioreactor Design	2

Technical Elective (p. 2)	2
GEP Requirement ( <a href="http://catalog.ncsu.edu/undergraduate/gep-category-requirements/">http://catalog.ncsu.edu/undergraduate/gep-category-requirements/</a> )	3
<b>Hours</b>	<b>15</b>
<b>Total Hours</b>	<b>128</b>

<sup>1</sup> A grade of C- or higher is required.

<sup>2</sup> A grade of C or higher is required.

## Career Opportunities

Careers in chemical engineering are sometimes exciting, always demanding, and ultimately provide a sense of accomplishment and achievement. Graduates find employment in sub-disciplines such as production, technical service, sales, management and administration; research and development; and consulting and teaching. Students desiring careers in teaching, research, or consulting are encouraged to continue their education and pursue a graduate degree (consult the Graduate Catalog). The undergraduate curriculum also provides strong preparation for graduate study in a wide range of professional specialties, and chemical engineering graduates often pursue careers in the medical sciences, business management, and law.

## Career Titles

- Agricultural Engineer
- Automotive Engineer
- Biochemist
- Biomedical Engineer
- Chemical Engineer
- Chemist
- Dairy Technologist
- Electronics Engineer
- Engineering Professor
- Environmental Engineer
- Fire Prevention Engineer
- Industrial Air Pollution Analyst
- Industrial Waste Inspector
- Laboratory Tester
- Materials Engineer
- Materials Scientist
- Nanosystems Engineers
- Non-Destructive Testing Specialists
- Nuclear Engineer
- Nuclear Fuels Research Engineer
- Occupational Safety & Health Inspector
- Perfumer
- Petroleum Engineer
- Physicist
- Physics Professor
- Product Safety Engineer
- Quality Control Managers
- Radiation Protection Engineer
- Safety Inspector
- Sales Engineers
- Sales Representative (Chemicals & Drugs)

- Soil Engineer
- Solar Energy Systems Engineers
- Sustainability Specialists
- Toxicologist
- Water/Wastewater Engineers

## Learn More About Careers

NCcareers.org (<https://nccareers.org/>)

Explore North Carolina's central online resource for students, parents, educators, job seekers and career counselors looking for high quality job and career information.

Occupational Outlook Handbook (<https://www.bls.gov/ooh/>)

Browse the Occupational Outlook Handbook published by the Bureau of Labor Statistics to view state and area employment and wage statistics. You can also identify and compare similar occupations based on your interests.

Career One Stop Videos (<https://www.careeronestop.org/>)

View videos that provide career details and information on wages, employment trends, skills needed, and more for any occupation. Sponsored by the U.S. Department of Labor.

Focus 2 Career Assessment (<https://careers.dasa.ncsu.edu/explore-careers/career-assessments/>) (NC State student email address required)

This career, major and education planning system is available to current NC State students to learn about how your values, interests, competencies, and personality fit into the NC State majors and your future career. An NC State email address is required to create an account. Make an appointment with your career counselor (<https://careers.dasa.ncsu.edu/about/hours-appointments/>) to discuss the results.

Focus 2 Apply Assessment (<https://www.focus2career.com/Portal/Register.cfm?SID=1929>) (Available to prospective students)

A career assessment tool designed to support prospective students in exploring and choosing the right major and career path based on your unique personality, interests, skills and values. Get started with Focus 2 Apply and see how it can guide your journey at NC State.

American Institute of Chemical Engineers (<https://www.aiche.org/>)

American Chemical Society (<https://www.acs.org/>)

American Oil Chemists' Society (<http://www.aocs.org/>)

National Society of Professional Engineers (<https://www.nspe.org/>)