

# MAJOR IN CHEMICAL AND BIOLOGICAL ENGINEERING, MOLECULAR MEDICINE CONCENTRATION

## Requirements Effective Fall 2025

Students may enroll in either the standalone major or (at most) one of the concentrations under the Major in Chemical and Biological Engineering.

### Freshman

		AUCC	Credits
CHEM 120 <sup>1</sup>	Foundations of Modern Chemistry (GT-SC2)	3A	4
CHEM 121 <sup>1</sup>	Foundations of Modern Chemistry Laboratory (GT-SC1)	3A	1
CO 150	College Composition (GT-CO2)	1A	3
ENGR 111	Fundamentals of Engineering		3
ENGR 114	Engineering for Grand Challenges		3
LIFE 102	Attributes of Living Systems (GT-SC1)	3A	4
MATH 160	Calculus for Physical Scientists I (GT-MA1)	1B	4
MATH 161	Calculus for Physical Scientists II (GT-MA1)	1B	4
1C ( <a href="http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#aucc">http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#aucc</a> )		1C	3
<b>Total Credits</b>			<b>29</b>

### Sophomore

CBE 201	Material and Energy Balances		3
CBE 205	Fundamentals of Biological Engineering		3
CBE 210	Thermodynamic Process Analysis		3
CBE 223	CBE Design and Experimentation I		2
CBE 393	Professional Development Seminar		1
CHEM 241	Foundations of Organic Chemistry		4
CHEM 242	Foundations of Organic Chemistry Laboratory		1
MATH 261	Calculus for Physical Scientists III		4
MATH 340	Intro to Ordinary Differential Equations		4
PH 141	Physics for Scientists and Engineers I (GT-SC1)	3A	5
Arts and Humanities ( <a href="http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-and-humanities">http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-and-humanities</a> )		3B	3
<b>Total Credits</b>			<b>33</b>

### Junior

BC 351 or CHEM 321	Principles of Biochemistry		4
	Foundations of Chemical Biology		
CBE 320	Chemical and Biological Reactor Design		3
CBE 330	Process Simulation		3
CBE 331	Momentum Transfer and Mechanical Separations		3
CBE 332	Heat and Mass Transfer Fundamentals		3
CBE 334	CBE Design and Experimentation II		1
CBE 335	CBE Design and Experimentation III		1
CBE 340	Statistics for CBE Applications		3

Bioscience Elective (see list below)		3
Chemistry Elective		6
Historical Perspectives ( <a href="http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#historical-perspectives">http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#historical-perspectives</a> )	3D	3

<b>Total Credits</b>		<b>33</b>
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**Senior**

CBE 430	Process Control and Instrumentation		3
CBE 442	Separation Processes		4
CBE 443	Chemical and Biological Engineering Lab II		2
CBE 451	Chemical and Biological Engineering Design I	4A,4B,4C	3
CBE 452	Chemical and Biological Engineering Design II	4A,4B,4C	3
Technical Elective (see list below)			9
Advanced Writing ( <a href="http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#advanced-writing">http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#advanced-writing</a> )		2	3
Arts and Humanities ( <a href="http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities">http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities</a> )		3B	3
Social and Behavioral Sciences ( <a href="http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#social-behavioral-sciences">http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#social-behavioral-sciences</a> )		3C	3

<b>Total Credits</b>		<b>33</b>
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<b>Program Total Credits:</b>		<b>128</b>
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<sup>1</sup> Students who complete General Chemistry (CHEM 111, CHEM 112, and CHEM 113, CHEM 114) do not have to take CHEM 120 and CHEM 121.

**Electives**

The CBE program requires 18 credit hours of electives. 12 credits of electives will be taken from a subset of CBE electives within Bioscience elective, Chemistry electives and Technical Electives to meet the requirements of the concentration. 3 credits Chemistry elective will be from the entire chemistry elective list available to CBEs. The last 3 credits of technical electives can be from any elective list listed below. New courses are added all the time, if you find a course you believe is valuable to your education just ask your advisor if it is an appropriate elective course.

**Bioscience Electives**

Select a minimum of 3 credits from the following.

Code	Title	Credits
BMS 300	Principles of Human Physiology	4
BMS 450	Pharmacology	3
BZ 240	Synthetic Biology-Principles and Applications	3
BZ 350 or LIFE 201B	Molecular and General Genetics Introductory Genetics: Molecular/Immunological/Developmental (GT-SC2)	4
BZ 360	Bioinformatics and Genomics	4
MIP 300	General Microbiology	3
MIP 315 or MIP 555	Pathology of Human and Animal Disease Principles and Mechanisms of Disease	3

**Chemistry Elective**

You need 6 credits total. Select 3 credits from Group A and 3 credits from Group A or B.

Code	Title	Credits
<b>Group A</b>		
BC 406A	Investigative Biochemistry: Protein Biochemistry	2
BC 406B	Investigative Biochemistry: Molecular Genetics	2
BC 411	Physical Biochemistry	4
BC 463	Molecular Genetics	3
BC 465	Molecular Regulation of Cell Function	3
BC 466	Molecular Regulation of Cell Function-Honors	1
CHEM 320	Chemistry of Addictions	3
CHEM 433	Clinical Chemistry	3
CHEM 442	Chemistry of Hemp and Cannabis	3
CHEM 448	Medicinal Chemistry	3
CHEM 521/BC 521	Principles of Chemical Biology	3
CHEM 522	Methods of Chemical Biology	2
<b>Group B</b>		
BC 400-479		
BC 500-579		
CBE 310	Molecular Concepts and Applications	3
CHEM 231	Foundations of Analytical Chemistry	3
CHEM 232	Foundations of Analytical Chemistry Lab	2
CHEM 261	Fundamentals of Inorganic Chemistry	3
CHEM 263	Foundations of Inorganic Chemistry	4
CHEM 264	Foundations of Inorganic Chemistry Laboratory	1
CHEM 310-340		
CHEM 350-379		
CHEM 400-479		
CHEM 500-579		

## Technical Electives

You need 9 credits total. 6 credits should be selected from the Technical Electives list A, Bioscience Elective List or from Chemistry Group A list.

3 credits can be selected from Technical Electives List B or any other electives listed on this page.

Code	Title	AUCC	Credits
<b>Technical Electives List A</b>			
BIOM 350B	Study Abroad--Portugal: Biomedical Engineering and Healthcare		1
BIOM 421	Transport Phenomena in Biomedical Engineering		3
BIOM 525/MECH 525	Cell and Tissue Engineering		3
BIOM 533/CIVE 533	Biomolecular Tools for Engineers		3
CBE 560	Engineering of Protein Expression Systems		3
CBE 570	Biomolecular Engineering/Synthetic Biology		3
ECE 527D/BIOM 527D	Biosensing: Electrochemical Sensors		1
ECE 527E/BIOM 527E	Biosensing: Affinity Sensors		1
MATH 455	Mathematics in Biology and Medicine		3
MIP 410	Foundations of Modern Biotechnology		2
MIP 420	Medical and Molecular Virology		4

Code	Title	AUCC	Credits
<b>Technical Electives List B</b>			
AB 410	Understanding Pesticides		3
ATS 350	Introduction to Weather and Climate		2
ATS 351	Introduction to Weather and Climate Lab		1
ATS 440/GES 440	Sea Level Rise and a Sustainable Future		3
ATS 542/GEOL 542	Paleoclimate		3
ATS 543/ESS 543	Global Climate Change		2
ATS 550	Atmospheric Radiation and Remote Sensing		3
ATS 555	Air Pollution		3
ATS 556	Climate Intervention to Cool a Warming Planet		2
ATS 560	Air Pollution Measurement		2
BIOM 300	Problem-Based Learning Biomedical Engr Lab		4
BIOM 304	Global Challenges and Collaborations in BME		3
BIOM 350A	Study Abroad--Ecuador: Prosthetics		1-3
BIOM 350C	Study Abroad--Ireland: Biomedical Engineering and Healthcare		1
BIOM 422	Quantitative Systems and Synthetic Biology		3
BIOM 517/ECE 517	Advanced Optical Imaging		3
BIOM 518/ECE 518	Biophotonics		3
BIOM 526/ECE 526	Biological Physics		3
BIOM 527A/ECE 527A	Biosensing: Cells as Circuits		1

BIOM 527B/ECE 527B	Biosensing: Signal and Noise in Biosensors	1
BIOM 527C/ECE 527C	Biosensing: Sensor Circuit Fundamentals	1
BIOM 527F/ECE 527F	Biosensing: Biophotonic Sensors Using Refractive Index	1
BIOM 531/MECH 531	Materials Engineering	3
BIOM 537/ECE 537	Biomedical Signal Processing	3
BIOM 570/MECH 570	Bioengineering	3
BIOM 572/MECH 572	Regenerative Bioengineering with Stem Cells	3
BIOM 573/MECH 573	Structure and Function of Biomaterials	3
BIOM 574/MECH 574	Bio-Inspired Surfaces	3
BIOM 576/MECH 576	Quantitative Systems Physiology	4
BIOM 578/MECH 578	Musculoskeletal Biosolid Mechanics	3
BIOM 579/MECH 579	Cardiovascular Biomechanics	3
BMS 301	Human Gross Anatomy	5
BMS 302	Laboratory in Principles of Physiology	2
BMS 305	Domestic Animal Gross Anatomy	4
BMS 325	Cellular Neurobiology	3
BMS 330	Microscopic Anatomy	4
BMS 345	Functional Neuroanatomy	4
BMS 360	Fundamentals of Physiology	4
BMS 409	Human and Animal Reproductive Biology	3
BMS 420	Cardiopulmonary Physiology	3
BMS 430	Endocrinology	3
BMS 460	Essentials of Pathophysiology	3
BMS 500	Mammalian Physiology I	4
BMS 501	Mammalian Physiology II	4
BMS 503/NB 503	Developmental Neurobiology	3
BMS 505/NB 505	Neuronal Circuits, Systems and Behavior	3
BMS 545	Neuroanatomy	5
BMS 575	Human Anatomy Dissection	4
BSPM 302	Applied and General Entomology	2
BSPM 361	Elements of Plant Pathology	3
BZ 310	Cell Biology	4
BZ 311	Developmental Biology	4
BZ 348/MATH 348	Theory of Population and Evolutionary Ecology	4
CBE 501	Chemical Engineering Thermodynamics	3
CBE 502	Advanced Reactor Design	3
CBE 503	Transport Phenomena Fundamentals	3
CBE 504/BIOM 504	Fundamentals of Biochemical Engineering	3
CBE 505	Biochemical Engineering Laboratory	1
CBE 514	Polymer Science and Engineering	3
CBE 521	Mathematical Modeling for Chemical Engineers	3

CBE 522/BIOM 522	Bioseparation Processes	3
CBE 524	Bioremediation	1
CBE 540/CIVE 540	Advanced Biological Wastewater Processing	3
CBE 543	Membranes for Biotechnology and Biomedicine	3
CIVE 260	Engineering Mechanics-Statics	3
CIVE 261	Engineering Mechanics-Dynamics	3
CIVE 322	Basic Hydrology	3
CIVE 330	Ecological Engineering	3
CIVE 360	Mechanics of Solids	3
CIVE 371	Study Abroad--Peru: Grand Challenges in Engineering in Peru	3
CIVE 401	Hydraulic Engineering	3
CIVE 421	Global Water Challenges	3
CIVE 423	Groundwater Engineering	3
CIVE 438	Fundamentals of Environmental Engr	3
CIVE 439	Applications of Environmental Engr Concepts	3
CIVE 440	Nonpoint Source Pollution	3
CIVE 441	Water Quality Analysis and Treatment	3
CIVE 442	Air Quality Engineering	3
CIVE 515	River Mechanics	3
CIVE 521	Hydrometry	3
CIVE 531	Groundwater Hydrology	3
CIVE 538	Aqueous Chemistry	3
CIVE 560	Advanced Mechanics of Materials	3
CS 165	CS2--Data Structures	4
CS 220	Discrete Structures and the Applications	4
CS 270	Computer Organization	4
ECE 204	Introduction to Electrical Engineering	3
ECE 430/MATH 430	Fourier and Wavelet Analysis with Apps	3
ENGR 300	3D Printing Lab for Engineers	1
ENGR 422	Technology Entrepreneurship	3
ENGR 478	Applied Engineering Data Analytics	3
ENGR 502	Engineering Project and Program Management	3
ENGR 510	Engineering Optimization: Method/ Application	3
ENGR 525	Intellectual Property and Invention Systems	3
ENGR 531	Engineering Risk Analysis	3
ENGR 550/MATH 550	Numerical Methods in Science and Engineering	3
ERHS 320	Environmental Health--Water Quality	3
ERHS 332	Principles of Epidemiology	3
ERHS 410	Environmental Health-Air and Waste Management	3
ERHS 446	Environmental Toxicology	3

ERHS 448	Environmental Contaminants		3
ERHS 450	Introduction to Radiation Biology		3
ERHS 502	Fundamentals of Toxicology		3
ERHS 503	Toxicology Principles		1
ERHS 510/VS 510	Cancer Biology		3
ERHS 530	Radiological Physics and Dosimetry I		3
ERHS 542	Biostatistical Methods for Qualitative Data		3
ERHS 547	Equipment and Instrumentation		3
ESS 311	Ecosystem Ecology		3
ESS 312	Sustainability Science		3
ESS 330	Quantitative Reasoning for Ecosystem Science		3
ESS 353	Global Change Impacts, Adaptation, Mitigation		3
ESS 440	Practicing Sustainability		4
ESS 501	Principles of Ecosystem Sustainability		3
ESS 524	Foundations for Carbon/Greenhouse Gas Mgmt		3
F 311	Forest Ecology		3
FIN 305	Fundamentals of Finance		3
FTEC 447	Food Chemistry		3
GEOL 150	Dynamic Earth (GT-SC2)	3A	4
GEOL 452	Hydrogeology		4
GEOL 454	Geomorphology		4
GES 362	Systems Thinking and Sustainability		3
GES 441	Analysis of Sustainable Energy Solutions		3
GES 465/MSE 465	Sustainable Strategies for E-Waste Management		3
GES 528/CIVE 528	Assessing the Food, Energy, Water Nexus		3
GES 542	Biobased Fuels, Energy, and Chemicals		3
HES 307	Biomechanical Principles of Human Movement		3
HES 319	Neuromuscular Aspects of Human Movement		4
HES 403	Physiology of Exercise		3
HES 420	Electrocardiography and Exercise Management		3
HORT 579	Mass Spectrometry Omics-Methods and Analysis		3
IDEA 310B	Design Thinking Toolbox: 3D Modeling		3
IDEA 310D	Design Thinking Toolbox: Digital Imaging		1
LIFE 201A	Introductory Genetics: Applied/Population/Conservation/Ecological (GT-SC2)	3A	3
LIFE 203	Introductory Genetics Laboratory		2
LIFE 210	Introductory Eukaryotic Cell Biology		3
LIFE 212	Introductory Cell Biology Laboratory		2

LIFE 320	Ecology	3
MATH 301	Introduction to Combinatorial Theory	3
MATH 331	Introduction to Mathematical Modeling	3
MATH 332	Partial Differential Equations	3
MATH 360	Mathematics of Information Security	3
MATH 366	Introduction to Abstract Algebra	3
MATH 369	Linear Algebra I	3
MATH 405	Introduction to Number Theory	3
MATH 419	Introduction to Complex Variables	3
MATH 450	Introduction to Numerical Analysis I	3
MATH 451	Introduction to Numerical Analysis II	3
MATH 460	Information and Coding Theory	3
MATH 466	Abstract Algebra I	3
MATH 467	Abstract Algebra II	3
MATH 469	Linear Algebra II	3
MATH 525	Optimal Control	3
MATH 530	Mathematics for Scientists and Engineers	3
MATH 532	Mathematical Modeling of Large Data Sets	3
MATH 535	Foundations of Applied Mathematics	3
MATH 546	Partial Differential Equations II	3
MATH 560	Linear Algebra	3
MECH 262	Engineering Mechanics	4
MECH 307	Mechatronics II	3
MECH 324	Dynamics of Machines	4
MECH 325	Machine Design with Finite Element Analysis	4
MECH 331	Introduction to Engineering Materials	4
MECH 403	Energy Engineering	3
MECH 407	Laser Applications in Mechanical Engineering	3
MECH 424	Advanced Dynamics	3
MECH 425	Mechanical Engineering Vibrations	4
MECH 431	Metals and Alloys	3
MECH 432	Engineering of Nanomaterials	3
MECH 436/MSE 436	Green Engineering—Materials and Environment	3
MECH 502	Advanced/Additive Manufacturing Engineering	3
MECH 507	Laser Diagnostics for Thermosciences	3
MECH 509	Design and Analysis in Engineering Research	3
MECH 513	Simulation Modeling and Experimentation	3
MECH 516	Life Cycle and Techno-Economic Assessment	3
MECH 524	Principles of Dynamics	3
MECH 527	Hybrid Electric Vehicle Powertrains	3
MECH 529	Advanced Mechanical Systems	3
MECH 530	Advanced Composite Materials	3

MECH 543	Biofluid Mechanics	3
MECH 552	Applied Computational Fluid Dynamics	3
MGT 305	Fundamentals of Management	3
MGT 340	Fundamentals of Entrepreneurship	3
MIP 302	General Microbiology Laboratory	2
MIP 334	Food Microbiology	3
MIP 335	Food Microbiology Laboratory	2
MIP 342	Immunology	4
MIP 343	Immunology Laboratory	2
MIP 351	Medical Bacteriology	3
MIP 352	Medical Bacteriology Laboratory	3
MIP 425	Virology and Cell Culture Laboratory	2
MIP 432/ESS 432	Microbial Ecology	3
MIP 433/ESS 433	Microbial Ecology Laboratory	1
MIP 443	Microbial Physiology	3
MIP 450	Microbial Genetics	3
MIP 530	Advanced Molecular Virology	4
MIP 543	RNA Biology	3
MIP 550	Microbial and Molecular Genetics Laboratory	4
MIP 555	Principles and Mechanisms of Disease	3
MKT 305	Fundamentals of Marketing	3
MSE 501	Materials Technology Transfer	1
MSE 502A	Materials Science and Engineering Methods: Materials Structure and Scattering	1
MSE 502B	Materials Science and Engineering Methods: Computational Materials Methods	1
MSE 502C	Materials Science and Engineering Methods: Materials Microscopy	1
MSE 502D	Materials Science and Engineering Methods: Materials Spectroscopy	1
MSE 502E	Materials Science and Engineering Methods: Bulk Properties and Performance	1
MSE 502F	Materials Science and Engineering Methods: Experimental Methods for Materials Research	1
MSE 503	Mechanical Behavior of Materials	3
MSE 504	Thermodynamics of Materials	3
MSE 505	Kinetics of Materials	3
NR 319	Introduction to Geospatial Science	4
NR 323/GR 323	Remote Sensing and Image Interpretation	3
NR 505	Concepts in GIS	4
PH 142	Physics for Scientists and Engineers 3A II (GT-SC1)	5
PH 314	Introduction to Modern Physics	4
PH 315	Modern Physics Laboratory	2
PH 341	Mechanics	4
PH 351	Electricity and Magnetism	4



PH 353	Optics and Waves	4
PH 361	Physical Thermodynamics	3
PH 451	Introductory Quantum Mechanics I	3
PH 452	Introductory Quantum Mechanics II	3
PH 517	Chaos, Fractals, and Nonlinear Dynamics	3
PH 521	Introduction to Lasers	3
PH 522	Introductory Laser Laboratory	1
PH 531	Introductory Condensed Matter Physics	3
PH 561	Elementary Particle Physics	3
PH 571	Mathematical Methods for Physics I	3
PH 572	Mathematical Methods for Physics II	3
PHIL 410	Gödel's Incompleteness Theorems	3
SOCR 322	Principles of Microclimatology	3
SOCR 330	Principles of Genetics	3
SOCR 375	Soil Biogeochemistry	3
SOCR 400	Soils and Global Change-Impacts and Solutions	3
SOCR 455	Microbiomes of Soil Systems	3
SOCR 456	Soil Microbiology Laboratory	1
SOCR 467	Soil and Environmental Chemistry	3
SOCR 470	Soil Physics	3
SOCR 471	Soil Physics Laboratory	1
SOCR 567	Environmental Soil Chemistry	4
STAR 512	Design and Data Analysis for Researchers II	4
STAT 305	Sampling Techniques	3
STAT 307	Introduction to Biostatistics	3
STAT 315	Intro to Theory and Practice of Statistics	3
STAT 341	Statistical Data Analysis I	3
STAT 342	Statistical Data Analysis II	3
STAT 400	Statistical Computing	3
STAT 420	Probability and Mathematical Statistics I	3
STAT 421	Introduction to Stochastic Processes	3
STAT 430	Probability and Mathematical Statistics II	3
STAT 460	Applied Multivariate Analysis	3
SYSE 501	Foundations of Systems Engineering	3
SYSE 505	Systems Thinking for the Real World	3
SYSE 512	Systems Sensing and Imaging Analysis	3
SYSE 530	Overview of Systems Engineering Processes	3
SYSE 532/ECE 532	Dynamics of Complex Engineering Systems	3
SYSE 534	Human Systems Integration	3
SYSE 536	Space Mission Analysis and Design	3
SYSE 541	Engineering Data Design and Visualization	3

SYSE 544	Systems-Based AR/VR Environmental Realism	3
SYSE 545	Augmented/Virtual Reality Systems Development	3
SYSE 548	Security Engineering for Systems Engineers	3
SYSE 549	Secure Vehicle and Industrial Networking	3
SYSE 555	Transitions in Energy Systems	3
SYSE 567	Systems Engineering Architecture	3
SYSE 569	Cybersecurity Awareness for Systems Engineers	3
SYSE 571	Analytics in Systems Engineering	3
SYSE 573	Cost Optimization for Systems Engineers	3