

# DUAL DEGREE PROGRAM: BIOMEDICAL ENGINEERING COMBINED WITH CHEMICAL AND BIOLOGICAL ENGINEERING

## Requirements Effective Fall 2025

### Freshman

		AUCC	Credits
CHEM 120	Foundations of Modern Chemistry (GT-SC2)	3A	4
CHEM 121	Foundations of Modern Chemistry Laboratory (GT-SC1)	3A	1
CO 150	College Composition (GT-CO2)	1A	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
Select one group from the following:			3
Group A:			
ENGR 111	Fundamentals of Engineering		
Group B:			
CBE 101	Introduction to Chemical and Biological Engr		
Group C:			
CBE 101A	Introduction to Chemical and Biological Engr: Lecture		
CBE 101B	Introduction to Chemical and Biological Engr: Laboratory		
CBE 160	MATLAB for Chemical and Biological Eng		
Group D:			
CBE 104A	Study Abroad–Denmark: Intro to Chemical and Biological Engineering		
Social and Behavioral Sciences ( <a href="https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#social-behavioral-sciences">https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#social-behavioral-sciences</a> )		3C	3

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### Total Credits

### 29

### 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

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### Total Credits

### 30

### Junior

BIOM 300	Problem-Based Learning Biomedical Engr Lab		4
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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
MECH 262	Engineering Mechanics	4
Select one of the following courses:		4
BC 351	Principles of Biochemistry	
BMS 300	Principles of Human Physiology	
Arts and Humanities ( <a href="https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities">https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities</a> )		3

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**Total Credits** **32**

**Senior**

BIOM 421	Transport Phenomena in Biomedical Engineering	3
BIOM 422	Quantitative Systems and Synthetic Biology	3
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	3
PH 142	Physics for Scientists and Engineers II (GT-SC1)	3A 5
BME Broad Elective (see list below)		3
Chemistry Elective (see list below)		3
Advanced Writing ( <a href="https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#advanced-writing">https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#advanced-writing</a> )		2 3
Historical Perspectives ( <a href="https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#historical-perspectives">https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#historical-perspectives</a> )		3D 3

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**Total Credits** **35**

**Fifth Year**

BIOM 486A	Biomedical Design Practicum: Capstone Design I	4A,4B,4C	4
BIOM 486B	Biomedical Design Practicum: Capstone Design II	4A,4B,4C	4
Select one of the following courses (one that you have not taken previously):			4
BC 351	Principles of Biochemistry		
BMS 300	Principles of Human Physiology		
BME Technical Elective			5
CBE Technical Elective			5
Chemistry Elective (see list below)			3
1C ( <a href="https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#aucc">https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#aucc</a> )		1C	3
Arts and Humanities ( <a href="https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities">https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities</a> )		3B	3

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**Total Credits** **31**

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**Program Total Credits:** **157**

**BME Technical Electives - Select 5 credits**

Code	Title	Credits			
BC 401	Comprehensive Biochemistry I	3	BC 465	Molecular Regulation of Cell Function	3
BC 403	Comprehensive Biochemistry II	3	BC 565	Molecular Regulation of Cell Function	4
BC 404	Comprehensive Biochemistry Laboratory	2	BIOM 304	Global Challenges and Collaborations in BME	3
BC 411	Physical Biochemistry	4	BIOM 350A	Study Abroad--Ecuador: Prosthetics	1-3
BC 463	Molecular Genetics	3	BIOM 431/ECE 431	Biomedical Signal and Image Processing	3
			BIOM 441	Biomechanics and Biomaterials	3

Select a maximum of 3 credits from the following:

BIOM 476	Biomedical Engineering Clinical Practicum	
BIOM 495	Independent Study	
BIOM 504/CBE 504	Fundamentals of Biochemical Engineering	3
BIOM 518/ECE 518	Biophotonics	3
BIOM 522/CBE 522	Bioseparation Processes	3
BIOM 525/MECH 525	Cell and Tissue Engineering	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 527D/ ECE 527D	Biosensing: Electrochemical Sensors	1
BIOM 527E/ ECE 527E	Biosensing: Affinity Sensors	1
BIOM 527F/ ECE 527F	Biosensing: Biophotonic Sensors Using Refractive Index	1
BIOM 531/MECH 531	Materials Engineering	3
BIOM 533/CIVE 533	Biomolecular Tools for Engineers	3
BIOM 537/ECE 537	Biomedical Signal Processing	3
BIOM 559/ECE 559	Machine Learning in Imaging and Spectroscopy	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 310	Anatomy for the Health Professions	4
BMS 320	Virtual Laboratory in Physiology	2
BMS 325	Cellular Neurobiology	3
BMS 345	Functional Neuroanatomy	4
BMS 405	Nerve and Muscle-Toxins, Trauma and Disease	3
BMS 409	Human and Animal Reproductive Biology	3
BMS 420	Cardiopulmonary Physiology	3
BMS 430	Endocrinology	3
BMS 450	Pharmacology	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
BZ 310	Cell Biology	4
BZ 311	Developmental Biology	4
BZ 350	Molecular and General Genetics	4
BZ 476/BZ 576	Genetics of Model Organisms	3
CBE 505	Biochemical Engineering Laboratory	1

CBE 543	Membranes for Biotechnology and Biomedicine	3
CHEM 334	Quantitative Analysis Laboratory	1
CHEM 335	Introduction to Analytical Chemistry	3
CHEM 433	Clinical Chemistry	3
CHEM 539A	Principles of NMR and MRI: Basic NMR Principles	1
CHEM 539B	Principles of NMR and MRI: NMR Diffusion Measurements-2D NMR and MRI	1
CHEM 539C	Principles of NMR and MRI: Advanced NMR and MRI Techniques	1
ECE 569/MECH 569	Micro-Electro-Mechanical Devices	3
ENGR 533	Spaceflight and Biological Systems	3
ERHS 332	Principles of Epidemiology	3
ERHS 450	Introduction to Radiation Biology	3
ERHS 502	Fundamentals of Toxicology	3
ERHS 510/VS 510	Cancer Biology	3
ERHS 540	Principles of Ergonomics	3
FSHN 470	Advanced Human Nutrition and Metabolism	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
HES 476	Exercise and Chronic Disease	3
MATH 455	Mathematics in Biology and Medicine	3
MECH 543	Biofluid Mechanics	3
MIP 300	General Microbiology	3
MIP 302	General Microbiology Laboratory	2
MIP 342	Immunology	4
MIP 343	Immunology Laboratory	2
MIP 351	Medical Bacteriology	3
MIP 352	Medical Bacteriology Laboratory	3
MIP 420	Medical and Molecular Virology	4
MIP 443	Microbial Physiology	3
MIP 450	Microbial Genetics	3
NB 500/BMS 502	Readings in Cellular Neurobiology	1

**CBE Technical Electives - Select 5 Credits**Select a minimum of 5 credits from the following or select additional credits from the [Chemistry](#) Electives list below.

Code	Title	Credits
AB 410	Understanding Pesticides	3
ATS 555	Air Pollution	3
ATS 560	Air Pollution Measurement	2
BC 401	Comprehensive Biochemistry I	3
BC 403	Comprehensive Biochemistry II	3
BC 404	Comprehensive Biochemistry Laboratory	2
BC 406A	Investigative Biochemistry: Protein Biochemistry	2

BC 406B	Investigative Biochemistry: Molecular Genetics	2	CBE 406	Introduction to Transport Phenomena	3
BC 406C	Investigative Biochemistry: Cellular Biochemistry	2	CBE 501	Chemical Engineering Thermodynamics	3
BC 411	Physical Biochemistry	4	CBE 502	Advanced Reactor Design	3
BC 441	3D Molecular Models for Biochemistry	1	CBE 503	Transport Phenomena Fundamentals	3
BC 463	Molecular Genetics	3	CBE 504/BIOM 504	Fundamentals of Biochemical Engineering	3
BC 464	Molecular Genetics Recitation	1	CBE 505	Biochemical Engineering Laboratory	1
BC 465	Molecular Regulation of Cell Function	3	CBE 514	Polymer Science and Engineering	3
BC 517	Metabolism	2	CBE 521	Mathematical Modeling for Chemical Engineers	3
BC 521/CHEM 521	Principles of Chemical Biology	3	CBE 522/BIOM 522	Bioseparation Processes	3
BIOM 350A	Study Abroad--Ecuador: Prosthetics	1-3	CBE 524	Bioremediation	1
BIOM 350B	Study Abroad--Portugal: Biomedical Engineering and Healthcare	1	CBE 540/CIVE 540	Advanced Biological Wastewater Processing	3
BIOM 441	Biomechanics and Biomaterials	3	CBE 560	Engineering of Protein Expression Systems	3
BIOM 517/ECE 517	Advanced Optical Imaging	3	CBE 570	Biomolecular Engineering/Synthetic Biology	3
BIOM 525/MECH 525	Cell and Tissue Engineering	3	CIVE 322	Basic Hydrology	3
BIOM 526/ECE 526	Biological Physics	3	CIVE 330	Ecological Engineering	3
BIOM 531/MECH 531	Materials Engineering	3	CIVE 360	Mechanics of Solids	3
BIOM 532/MECH 532	Materials Issues in Mechanical Design	3	CIVE 371	Study Abroad--Peru: Grand Challenges in Engineering in Peru	3
BIOM 533/CIVE 533	Biomolecular Tools for Engineers	3	CIVE 401	Hydraulic Engineering	3
BIOM 537/ECE 537	Biomedical Signal Processing	3	CIVE 423	Groundwater Engineering	3
BIOM 573/MECH 573	Structure and Function of Biomaterials	3	CIVE 438	Fundamentals of Environmental Engr	3
BIOM 574/MECH 574	Bio-Inspired Surfaces	3	CIVE 439	Applications of Environmental Engr Concepts	3
BIOM 576/MECH 576	Quantitative Systems Physiology	4	CIVE 440	Nonpoint Source Pollution	3
BIOM 579/MECH 579	Cardiovascular Biomechanics	3	CIVE 442	Air Quality Engineering	3
BMS 301	Human Gross Anatomy	5	CIVE 515	River Mechanics	3
BMS 302	Laboratory in Principles of Physiology	2	CIVE 520	Physical Hydrology	3
BMS 305	Domestic Animal Gross Anatomy	4	CIVE 531	Groundwater Hydrology	3
BMS 325	Cellular Neurobiology	3	CIVE 538	Aqueous Chemistry	3
BMS 330	Microscopic Anatomy	4	CIVE 560	Advanced Mechanics of Materials	3
BMS 345	Functional Neuroanatomy	4	CS 165	CS2--Data Structures	4
BMS 409	Human and Animal Reproductive Biology	3	CS 220	Discrete Structures and the Applications	4
BMS 420	Cardiopulmonary Physiology	3	CS 270	Computer Organization	4
BMS 430	Endocrinology	3	ECE 204	Introduction to Electrical Engineering	3
BMS 450	Pharmacology	3	ECE 430/MATH 430	Fourier and Wavelet Analysis with Apps	3
BMS 460	Essentials of Pathophysiology	3	ECE 527A/ BIOM 527A	Biosensing: Cells as Circuits	1
BMS 500	Mammalian Physiology I	4	ECE 527B/ BIOM 527B	Biosensing: Signal and Noise in Biosensors	1
BMS 501	Mammalian Physiology II	4	ECE 527C/ BIOM 527C	Biosensing: Sensor Circuit Fundamentals	1
BMS 503/NB 503	Developmental Neurobiology	3	ECE 527D/ BIOM 527D	Biosensing: Electrochemical Sensors	1
BMS 505/NB 505	Neuronal Circuits, Systems and Behavior	3	ECE 527E/ BIOM 527E	Biosensing: Affinity Sensors	1
BMS 545	Neuroanatomy	5	ECE 527F/ BIOM 527F	Biosensing: Biophotonic Sensors Using Refractive Index	1
BMS 575	Human Anatomy Dissection	4	ENGR 478	Applied Engineering Data Analytics	3
BSPM 302	Applied and General Entomology	2	ENGR 510	Engineering Optimization: Method/ Application	3
BSPM 361	Elements of Plant Pathology	3			
BZ 240	Synthetic Biology-Principles and Applications	3			
BZ 310	Cell Biology	4			
BZ 311	Developmental Biology	4			
BZ 348/MATH 348	Theory of Population and Evolutionary Ecology	4			
BZ 350	Molecular and General Genetics	4			
BZ 360	Bioinformatics and Genomics	4			

ENGR 550/ MATH 550	Numerical Methods in Science and Engineering	3	MATH 360	Mathematics of Information Security	3
ERHS 320	Environmental Health–Water Quality	3	MATH 366	Introduction to Abstract Algebra	3
ERHS 332	Principles of Epidemiology	3	MATH 369	Linear Algebra I	3
ERHS 410	Environmental Health–Air and Waste Management	3	MATH 405	Introduction to Number Theory	3
ERHS 446	Environmental Toxicology	3	MATH 419	Introduction to Complex Variables	3
ERHS 448	Environmental Contaminants	3	MATH 450	Introduction to Numerical Analysis I	3
ERHS 450	Introduction to Radiation Biology	3	MATH 451	Introduction to Numerical Analysis II	3
ERHS 502	Fundamentals of Toxicology	3	MATH 455	Mathematics in Biology and Medicine	3
ERHS 503	Toxicology Principles	1	MATH 460	Information and Coding Theory	3
ERHS 510/VS 510	Cancer Biology	3	MATH 466	Abstract Algebra I	3
ERHS 530	Radiological Physics and Dosimetry I	3	MATH 467	Abstract Algebra II	3
ERHS 542	Biostatistical Methods for Qualitative Data	3	MATH 469	Linear Algebra II	3
ERHS 547	Equipment and Instrumentation	3	MATH 525	Optimal Control	3
ESS 311	Ecosystem Ecology	3	MATH 530	Mathematics for Scientists and Engineers	3
ESS 312	Sustainability Science	3	MATH 532	Mathematical Modeling of Large Data Sets	3
ESS 330	Quantitative Reasoning for Ecosystem Science	3	MATH 535	Foundations of Applied Mathematics	3
ESS 440	Practicing Sustainability	4	MATH 546	Partial Differential Equations II	3
ESS 501	Principles of Ecosystem Sustainability	3	MATH 560	Linear Algebra	3
ESS 524	Foundations for Carbon/Greenhouse Gas Mgmt	3	MECH 307	Mechatronics II	3
F 311	Forest Ecology	3	MECH 324	Dynamics of Machines	4
FTEC 447	Food Chemistry	3	MECH 325	Machine Design with Finite Element Analysis	4
GEOL 150	Dynamic Earth (GT-SC2)	4	MECH 331	Introduction to Engineering Materials	4
GEOL 452	Hydrogeology	4	MECH 403	Energy Engineering	3
GEOL 454	Geomorphology	4	MECH 407	Laser Applications in Mechanical Engineering	3
GES 362	Systems Thinking and Sustainability	3	MECH 424	Advanced Dynamics	3
GES 441	Analysis of Sustainable Energy Solutions	3	MECH 425	Mechanical Engineering Vibrations	4
GES 465/MSE 465	Sustainable Strategies for E-Waste Management	3	MECH 431	Metals and Alloys	3
GES 528/CIVE 528	Assessing the Food, Energy, Water Nexus	3	MECH 432	Engineering of Nanomaterials	3
GES 542	Biobased Fuels, Energy, and Chemicals	3	MECH 436/MSE 436	Green Engineering–Materials and Environment	3
HES 307	Biomechanical Principles of Human Movement	3	MECH 502	Advanced/Additive Manufacturing Engineering	3
HES 319	Neuromuscular Aspects of Human Movement	4	MECH 507	Laser Diagnostics for Thermosciences	3
HES 403	Physiology of Exercise	3	MECH 509	Design and Analysis in Engineering Research	3
HES 420	Electrocardiography and Exercise Management	3	MECH 513	Simulation Modeling and Experimentation	3
HORT 579	Mass Spectrometry Omics-Methods and Analysis	3	MECH 516	Life Cycle and Techno-Economic Assessment	3
LIFE 201B	Introductory Genetics: Molecular/Immunological/Developmental (GT-SC2)	3	MECH 524	Principles of Dynamics	3
LIFE 202B	Introductory Genetics Recitation: Molecular	1	MECH 527	Hybrid Electric Vehicle Powertrains	3
LIFE 203	Introductory Genetics Laboratory	2	MECH 529	Advanced Mechanical Systems	3
LIFE 210	Introductory Eukaryotic Cell Biology	3	MECH 530	Advanced Composite Materials	3
LIFE 211	Introductory Cell Biology Honors Recitation	1	MECH 543	Biofluid Mechanics	3
LIFE 212	Introductory Cell Biology Laboratory	2	MECH 552	Applied Computational Fluid Dynamics	3
LIFE 320	Ecology	3	MIP 300	General Microbiology	3
MATH 301	Introduction to Combinatorial Theory	3	MIP 302	General Microbiology Laboratory	2
MATH 331	Introduction to Mathematical Modeling	3	MIP 315	Pathology of Human and Animal Disease	3
MATH 332	Partial Differential Equations	3	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	SOCR 400	Soils and Global Change-Impacts and Solutions	3
MIP 352	Medical Bacteriology Laboratory	3	SOCR 455	Microbiomes of Soil Systems	3
MIP 410	Foundations of Modern Biotechnology	2	SOCR 456	Soil Microbiology Laboratory	1
MIP 420	Medical and Molecular Virology	4	SOCR 467	Soil and Environmental Chemistry	3
MIP 425	Virology and Cell Culture Laboratory	2	SOCR 470	Soil Physics	3
MIP 432/ESS 432	Microbial Ecology	3	SOCR 471	Soil Physics Laboratory	1
MIP 433/ESS 433	Microbial Ecology Laboratory	1	SOCR 567	Environmental Soil Chemistry	4
MIP 443	Microbial Physiology	3	STAR 512	Design and Data Analysis for Researchers II	4
MIP 450	Microbial Genetics	3	STAT 305	Sampling Techniques	3
MIP 530	Advanced Molecular Virology	4	STAT 307	Introduction to Biostatistics	3
MIP 543	RNA Biology	3	STAT 341	Statistical Data Analysis I	3
MIP 550	Microbial and Molecular Genetics Laboratory	4	STAT 342	Statistical Data Analysis II	3
MIP 555	Principles and Mechanisms of Disease	3	STAT 400	Statistical Computing	3
MSE 501	Materials Technology Transfer	1	STAT 420	Probability and Mathematical Statistics I	3
MSE 502A	Materials Science and Engineering Methods: Materials Structure and Scattering	1	STAT 421	Introduction to Stochastic Processes	3
MSE 502B	Materials Science and Engineering Methods: Computational Materials Methods	1	STAT 430	Probability and Mathematical Statistics II	3
MSE 502C	Materials Science and Engineering Methods: Materials Microscopy	1	STAT 460	Applied Multivariate Analysis	3
MSE 502D	Materials Science and Engineering Methods: Materials Spectroscopy	1	SYSE 530	Overview of Systems Engineering Processes	3
MSE 502E	Materials Science and Engineering Methods: Bulk Properties and Performance	1	SYSE 532/ECE 532	Dynamics of Complex Engineering Systems	3
MSE 502F	Materials Science and Engineering Methods: Experimental Methods for Materials Research	1	A maximum of 3 credits may be selected from the following courses:		
MSE 503	Mechanical Behavior of Materials	3	ENGR 422	Technology Entrepreneurship	
MSE 504	Thermodynamics of Materials	3	ENGR 502	Engineering Project and Program Management	
MSE 505	Kinetics of Materials	3	ENGR 525	Intellectual Property and Invention Systems	
NR 319	Introduction to Geospatial Science	4	FIN 305	Fundamentals of Finance	
NR 323/GR 323	Remote Sensing and Image Interpretation	3	IDEA 310B	Design Thinking Toolbox: 3D Modeling	
NR 505	Concepts in GIS	4	IDEA 310D	Design Thinking Toolbox: Digital Imaging	
PH 314	Introduction to Modern Physics	4	MGT 305	Fundamentals of Management	
PH 315	Modern Physics Laboratory	2	MGT 340	Fundamentals of Entrepreneurship	
PH 341	Mechanics	4	MKT 305	Fundamentals of Marketing	
PH 351	Electricity and Magnetism	4	<b>Chemistry Electives - Select 6 Credits</b>		
PH 353	Optics and Waves	4	<b>Code</b>	<b>Title</b>	<b>Credits</b>
PH 361	Physical Thermodynamics	3	BC 400-479		
PH 451	Introductory Quantum Mechanics I	3	BC 500-579		
PH 452	Introductory Quantum Mechanics II	3	CBE 310	Molecular Concepts and Applications	3
PH 517	Chaos, Fractals, and Nonlinear Dynamics	3	CHEM 231	Foundations of Analytical Chemistry	3
PH 521	Introduction to Lasers	3	CHEM 232	Foundations of Analytical Chemistry Lab	2
PH 522	Introductory Laser Laboratory	1	CHEM 261	Fundamentals of Inorganic Chemistry	3
PH 531	Introductory Condensed Matter Physics	3	CHEM 263	Foundations of Inorganic Chemistry	4
PH 561	Elementary Particle Physics	3	CHEM 264	Foundations of Inorganic Chemistry Laboratory	1
PH 571	Mathematical Methods for Physics I	3	CHEM 310-340		
PHIL 410	Gödel's Incompleteness Theorems	3	CHEM 350-379		
SOCR 322	Principles of Microclimatology	3	CHEM 400-479		
SOCR 330	Principles of Genetics	3	CHEM 500-579		
SOCR 375	Soil Biogeochemistry	3			

**BME Broad Electives – Select 3 credits**

Code	Title	Credits
AB 410	Understanding Pesticides	3
ART 231	Photo Image Making for Non-Art Majors	3
ATS 550	Atmospheric Radiation and Remote Sensing	3
ATS 555	Air Pollution	3
ATS 560	Air Pollution Measurement	2
BC 401	Comprehensive Biochemistry I	3
BC 403	Comprehensive Biochemistry II	3
BC 404	Comprehensive Biochemistry Laboratory	2
BC 406A	Investigative Biochemistry: Protein Biochemistry	2
BC 406B	Investigative Biochemistry: Molecular Genetics	2
BC 406C	Investigative Biochemistry: Cellular Biochemistry	2
BC 411	Physical Biochemistry	4
BC 441	3D Molecular Models for Biochemistry	1
BC 463	Molecular Genetics	3
BC 464	Molecular Genetics Recitation	1
BC 465	Molecular Regulation of Cell Function	3
BC 517	Metabolism	2
BC 521/CHEM 521	Principles of Chemical Biology	3
BC 563	Molecular Genetics	4
BIOM 304	Global Challenges and Collaborations in BME	3
BIOM 350A	Study Abroad–Ecuador: Prosthetics	1-3
BIOM 350B	Study Abroad–Portugal: Biomedical Engineering and Healthcare	1
BIOM 431/ECE 431	Biomedical Signal and Image Processing	3
BIOM 441	Biomechanics and Biomaterials	3
BIOM 504/CBE 504	Fundamentals of Biochemical Engineering	3
BIOM 517/ECE 517	Advanced Optical Imaging	3
BIOM 518/ECE 518	Biophotonics	3
BIOM 522/CBE 522	Bioseparation Processes	3
BIOM 525/MECH 525	Cell and Tissue Engineering	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 527D/ ECE 527D	Biosensing: Electrochemical Sensors	1
BIOM 527E/ ECE 527E	Biosensing: Affinity Sensors	1
BIOM 527F/ ECE 527F	Biosensing: Biophotonic Sensors Using Refractive Index	1
BIOM 531/MECH 531	Materials Engineering	3
BIOM 532/MECH 532	Materials Issues in Mechanical Design	3
BIOM 533/CIVE 533	Biomolecular Tools for Engineers	3
BIOM 537/ECE 537	Biomedical Signal Processing	3
BIOM 559/ECE 559	Machine Learning in Imaging and Spectroscopy	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 310	Anatomy for the Health Professions	4
BMS 320	Virtual Laboratory in Physiology	2
BMS 325	Cellular Neurobiology	3
BMS 330	Microscopic Anatomy	4
BMS 345	Functional Neuroanatomy	4
BMS 405	Nerve and Muscle-Toxins, Trauma and Disease	3
BMS 409	Human and Animal Reproductive Biology	3
BMS 420	Cardiopulmonary Physiology	3
BMS 430	Endocrinology	3
BMS 450	Pharmacology	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 240	Synthetic Biology-Principles and Applications	3
BZ 310	Cell Biology	4
BZ 311	Developmental Biology	4
BZ 348/MATH 348	Theory of Population and Evolutionary Ecology	4
BZ 350	Molecular and General Genetics	4
BZ 360	Bioinformatics and Genomics	4
BZ 420	Evolutionary Medicine	3
BZ 476/BZ 576	Genetics of Model Organisms	3
CBE 406	Introduction to Transport Phenomena	3
CBE 501	Chemical Engineering Thermodynamics	3
CBE 502	Advanced Reactor Design	3
CBE 503	Transport Phenomena Fundamentals	3
CBE 505	Biochemical Engineering Laboratory	1
CBE 514	Polymer Science and Engineering	3
CBE 521	Mathematical Modeling for Chemical Engineers	3
CBE 524	Bioremediation	1

CBE 540/CIVE 540	Advanced Biological Wastewater Processing	3	CHEM 578A	Computational Chemistry: Electronic Structure	1
CBE 560	Engineering of Protein Expression Systems	3	CHEM 579	Chemical Kinetics	3
CBE 570	Biomolecular Engineering/Synthetic Biology	3	CIVE 322	Basic Hydrology	3
CHEM 231	Foundations of Analytical Chemistry	3	CIVE 330	Ecological Engineering	3
CHEM 232	Foundations of Analytical Chemistry Lab	2	CIVE 360	Mechanics of Solids	3
CHEM 261	Fundamentals of Inorganic Chemistry	3	CIVE 367	Structural Analysis	3
CHEM 263	Foundations of Inorganic Chemistry	4	CIVE 371	Study Abroad--Peru: Grand Challenges in Engineering in Peru	3
CHEM 264	Foundations of Inorganic Chemistry Laboratory	1	CIVE 401	Hydraulic Engineering	3
CHEM 311	Introduction to Nanoscale Science	3	CIVE 423	Groundwater Engineering	3
CHEM 315	Foundations of Polymer Chemistry	3	CIVE 438	Fundamentals of Environmental Engr	3
CHEM 320	Chemistry of Additions	3	CIVE 439	Applications of Environmental Engr Concepts	3
CHEM 333	Forensic Chemistry	3	CIVE 440	Nonpoint Source Pollution	3
CHEM 334	Quantitative Analysis Laboratory	1	CIVE 442	Air Quality Engineering	3
CHEM 335	Introduction to Analytical Chemistry	3	CIVE 515	River Mechanics	3
CHEM 338	Environmental Chemistry	3	CIVE 520	Physical Hydrology	3
CHEM 355	Foundations of Sustainable Chemistry	3	CIVE 524/WR 524	Modeling Watershed Hydrology	3
CHEM 431	Instrumental Analysis	4	CIVE 531	Groundwater Hydrology	3
CHEM 433	Clinical Chemistry	3	CIVE 538	Aqueous Chemistry	3
CHEM 440	Advanced Organic Chemistry Laboratory	2	CIVE 560	Advanced Mechanics of Materials	3
CHEM 445	Synthetic Organic Chemistry	3	CIVE 562	Fundamentals of Vibrations	3
CHEM 448	Medicinal Chemistry	3	CS 152	Python for STEM	2
CHEM 451	Foundations of Catalytic Chemistry	3	CS 164	CS1--Computational Thinking with Java	4
CHEM 461	Inorganic Chemistry	3	CS 165	CS2--Data Structures	4
CHEM 462	Inorganic Chemistry Laboratory	2	CS 220	Discrete Structures and the Applications	4
CHEM 465	Chemistry of Sustainable E-Waste Management	1	CS 253	Software Development with C++	4
CHEM 522	Methods of Chemical Biology	2	CS 270	Computer Organization	4
CHEM 532	Advanced Chemical Analysis II	3	CS 314	Software Engineering	3
CHEM 537	Electrochemical Methods	3	CS 320	Algorithms--Theory and Practice	3
CHEM 539A	Principles of NMR and MRI: Basic NMR Principles	1	CS 356	Systems Security	3
CHEM 539B	Principles of NMR and MRI: NMR Diffusion Measurements-2D NMR and MRI	1	CS 370	Operating Systems	3
CHEM 539C	Principles of NMR and MRI: Advanced NMR and MRI Techniques	1	CS 4**	- Any 400-level CS course except CS 495	
CHEM 541	Organic Molecular Structure Determination	2	CS 5**	- Any 500-level CS course	
CHEM 543	Structure/Mechanisms in Organic Chemistry	2	DSCI 320/MATH 320	Optimization Methods in Data Science	3
CHEM 545	Synthetic Organic Chemistry I	3	DSCI 369	Linear Algebra for Data Science	3-4
CHEM 547	Physical Organic Chemistry	3	or MATH 369	Linear Algebra I	
CHEM 555	Chemistry of Sustainability	3	ECE 204	Introduction to Electrical Engineering	3
CHEM 560	Foundations of Inorganic Synthesis	1	ECE 312	Linear System Analysis II	3
CHEM 566	Bioinorganic Chemistry	3	ECE 4**	- any ECE course at the 400-level except ECE 495	
CHEM 567	Crystallographic Computation	1	ECE 5**	- any ECE course at the 500-level	
CHEM 569	Chemical Crystallography	3	ENGR 300	3D Printing Lab for Engineers	1
CHEM 570	Chemical Bonding	3	ENGR 422	Technology Entrepreneurship	3
CHEM 575	Fundamentals of Chemical Thermodynamics	1	ENGR 478	Applied Engineering Data Analytics	3
CHEM 576	Statistical Mechanics	2	ENGR 502	Engineering Project and Program Management	3
CHEM 577	Surface Chemistry	3	ENGR 510	Engineering Optimization: Method/ Application	3
			ENGR 525	Intellectual Property and Invention Systems	3
			ENGR 531	Engineering Risk Analysis	3
			ENGR 533	Spaceflight and Biological Systems	3

ENGR 550/ MATH 550	Numerical Methods in Science and Engineering	3	HES 420	Electrocardiography and Exercise Management	3
ENGR 570	Coupled Electromechanical Systems	3	HES 476	Exercise and Chronic Disease	3
ERHS 320	Environmental Health–Water Quality	3	HORT 579	Mass Spectrometry Omics-Methods and Analysis	3
ERHS 332	Principles of Epidemiology	3	IDEA 310B	Design Thinking Toolbox: 3D Modeling	3
ERHS 400	Radiation Safety	3	IDEA 310D	Design Thinking Toolbox: Digital Imaging	1
ERHS 410	Environmental Health-Air and Waste Management	3	IDEA 310H/CS 310H	Design Thinking Toolbox: Mixed Reality Design	3
ERHS 430	Human Disease and the Environment	3	IDEA 455/MGT 455	Designing for Defense	3
ERHS 446	Environmental Toxicology	3	LIFE 201B	Introductory Genetics: Molecular/ Immunological/Developmental (GT-SC2)	3
ERHS 448	Environmental Contaminants	3	LIFE 202B	Introductory Genetics Recitation: Molecular	1
ERHS 450	Introduction to Radiation Biology	3	LIFE 203	Introductory Genetics Laboratory	2
ERHS 502	Fundamentals of Toxicology	3	LIFE 210	Introductory Eukaryotic Cell Biology	3
ERHS 503	Toxicology Principles	1	LIFE 211	Introductory Cell Biology Honors Recitation	1
ERHS 510/VS 510	Cancer Biology	3	LIFE 212	Introductory Cell Biology Laboratory	2
ERHS 530	Radiological Physics and Dosimetry I	3	LIFE 320	Ecology	3
ERHS 540	Principles of Ergonomics	3	LSPA 340	Spanish for Animal Health and Care Fields	3
ERHS 542	Biostatistical Methods for Qualitative Data	3	LSPA 346	Spanish for Health Care	3
ERHS 547	Equipment and Instrumentation	3	MATH 229	Matrices and Linear Equations	2
ERHS 560	Health Impact Assessment	2	MATH 235	Introduction to Mathematical Reasoning	2
ESS 311	Ecosystem Ecology	3	MATH 301	Introduction to Combinatorial Theory	3
ESS 312	Sustainability Science	3	MATH 317	Advanced Calculus of One Variable	3
ESS 330	Quantitative Reasoning for Ecosystem Science	3	MATH 331	Introduction to Mathematical Modeling	3
ESS 353	Global Change Impacts, Adaptation, Mitigation	3	MATH 332	Partial Differential Equations	3
ESS 440	Practicing Sustainability	4	MATH 360	Mathematics of Information Security	3
ESS 501	Principles of Ecosystem Sustainability	3	MATH 366	Introduction to Abstract Algebra	3
ESS 524	Foundations for Carbon/Greenhouse Gas Mgmt	3	MATH 405	Introduction to Number Theory	3
F 311	Forest Ecology	3	MATH 417	Advanced Calculus I	3
FIN 305	Fundamentals of Finance	3	MATH 418	Advanced Calculus II	3
FSHN 470	Advanced Human Nutrition and Metabolism	3	MATH 419	Introduction to Complex Variables	3
FTEC 447	Food Chemistry	3	MATH 430/ECE 430	Fourier and Wavelet Analysis with Apps	3
GEOL 150	Dynamic Earth (GT-SC2)	4	MATH 450	Introduction to Numerical Analysis I	3
GEOL 452	Hydrogeology	4	MATH 451	Introduction to Numerical Analysis II	3
GEOL 454	Geomorphology	4	MATH 455	Mathematics in Biology and Medicine	3
GES 362	Systems Thinking and Sustainability	3	MATH 460	Information and Coding Theory	3
GES 441	Analysis of Sustainable Energy Solutions	3	MATH 463	Post-Quantum Cryptography	3
GES 450	Global Sustainability and Health	3	MATH 466	Abstract Algebra I	3
GES 465/MSE 465	Sustainable Strategies for E-Waste Management	3	MATH 467	Abstract Algebra II	3
GES 528/CIVE 528	Assessing the Food, Energy, Water Nexus	3	MATH 469	Linear Algebra II	3
GES 542	Biobased Fuels, Energy, and Chemicals	3	MATH 470	Euclidean and Non-Euclidean Geometry	3
GR 305	Geography of Global Health	3	MATH 474	Introduction to Differential Geometry	3
HES 207	Anatomical Kinesiology	4	MATH 525	Optimal Control	3
HES 307	Biomechanical Principles of Human Movement	3	MATH 530	Mathematics for Scientists and Engineers	3
HES 319	Neuromuscular Aspects of Human Movement	4	MATH 532	Mathematical Modeling of Large Data Sets	3
HES 345	Population Health and Disease Prevention	3	MATH 535	Foundations of Applied Mathematics	3
HES 403	Physiology of Exercise	3	MATH 546	Partial Differential Equations II	3
			MATH 560	Linear Algebra	3
			MATH 569A/ DSCI 569A	Linear Algebra for Data Science: Matrices and Vectors Spaces	1
			MATH 569B/ DSCI 569B	Linear Algebra for Data Science: Geometric Techniques for Data Reduction	1

MATH 569C/ DSCI 569C	Linear Algebra for Data Science: Matrix Factorizations and Transformations	1	MSE 505	Kinetics of Materials	3
MATH 569D/ DSCI 569D	Linear Algebra for Data Science: Theoretical Foundations	1	NR 319	Introduction to Geospatial Science	4
MECH 200	Introduction to Manufacturing Processes	3	NR 323/GR 323	Remote Sensing and Image Interpretation	3
MECH 307	Mechatronics II	3	NR 505	Concepts in GIS	4
MECH 324	Dynamics of Machines	4	PH 314	Introduction to Modern Physics	4
MECH 325	Machine Design with Finite Element Analysis	4	PH 315	Modern Physics Laboratory	2
MECH 331	Introduction to Engineering Materials	4	PH 341	Mechanics	4
MECH 4** - Any 400-level MECH course except MECH 495			PH 351	Electricity and Magnetism	4
MECH 5** - Any 500-level MECH course			PH 353	Optics and Waves	4
MGT 305	Fundamentals of Management	3	PH 361	Physical Thermodynamics	3
MGT 340	Fundamentals of Entrepreneurship	3	PH 425	Advanced Physics Laboratory	2
MIP 300	General Microbiology	3	PH 451	Introductory Quantum Mechanics I	3
MIP 302	General Microbiology Laboratory	2	PH 452	Introductory Quantum Mechanics II	3
MIP 315	Pathology of Human and Animal Disease	3	PH 462	Statistical Physics	3
MIP 334	Food Microbiology	3	PH 517	Chaos, Fractals, and Nonlinear Dynamics	3
MIP 335	Food Microbiology Laboratory	2	PH 521	Introduction to Lasers	3
MIP 342	Immunology	4	PH 522	Introductory Laser Laboratory	1
MIP 343	Immunology Laboratory	2	PH 531	Introductory Condensed Matter Physics	3
MIP 351	Medical Bacteriology	3	PH 561	Elementary Particle Physics	3
MIP 352	Medical Bacteriology Laboratory	3	PH 571	Mathematical Methods for Physics I	3
MIP 410	Foundations of Modern Biotechnology	2	PHIL 322	Biomedical Ethics	3
MIP 420	Medical and Molecular Virology	4	PHIL 410	Gödel's Incompleteness Theorems	3
MIP 425	Virology and Cell Culture Laboratory	2	PSY 253	Human Factors and Engineering Psychology	3
MIP 432/ESS 432	Microbial Ecology	3	SOCR 322	Principles of Microclimatology	3
MIP 433/ESS 433	Microbial Ecology Laboratory	1	SOCR 330	Principles of Genetics	3
MIP 443	Microbial Physiology	3	SOCR 375	Soil Biogeochemistry	3
MIP 450	Microbial Genetics	3	SOCR 400	Soils and Global Change-Impacts and Solutions	3
MIP 530	Advanced Molecular Virology	4	SOCR 455	Microbiomes of Soil Systems	3
MIP 543	RNA Biology	3	SOCR 456	Soil Microbiology Laboratory	1
MIP 550	Microbial and Molecular Genetics Laboratory	4	SOCR 467	Soil and Environmental Chemistry	3
MIP 555	Principles and Mechanisms of Disease	3	SOCR 470	Soil Physics	3
MKT 305	Fundamentals of Marketing	3	SOCR 471	Soil Physics Laboratory	1
MSE 501	Materials Technology Transfer	1	SOCR 567	Environmental Soil Chemistry	4
MSE 502A	Materials Science and Engineering Methods: Materials Structure and Scattering	1	SPCM 434	International and Intercultural Communication	3
MSE 502B	Materials Science and Engineering Methods: Computational Materials Methods	1	STAR 512	Design and Data Analysis for Researchers II	4
MSE 502C	Materials Science and Engineering Methods: Materials Microscopy	1	STAT 158	Introduction to R Programming	1
MSE 502D	Materials Science and Engineering Methods: Materials Spectroscopy	1	STAT 305	Sampling Techniques	3
MSE 502E	Materials Science and Engineering Methods: Bulk Properties and Performance	1	STAT 307	Introduction to Biostatistics	3
MSE 502F	Materials Science and Engineering Methods: Experimental Methods for Materials Research	1	STAT 331	Intermediate Applied Statistical Methods	3
MSE 503	Mechanical Behavior of Materials	3	STAT 341	Statistical Data Analysis I	3
MSE 504	Thermodynamics of Materials	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 530	Overview of Systems Engineering Processes	3
SYSE 532/ECE 532	Dynamics of Complex Engineering Systems	3
SYSE 534	Human Systems Integration	3
VS 333	Domestic Animal Anatomy	4