

# DUAL DEGREE PROGRAM: BIOMEDICAL ENGINEERING COMBINED WITH ELECTRICAL ENGINEERING, LASERS AND OPTICAL ENGINEERING CONCENTRATION

requires a cumulative grade point average of at least 2.000 in ECE courses as a graduation requirement. It is the responsibility of any student who fails to maintain a 2.000 average to work with their advisor to correct grade point deficiencies. In addition, it is required that students retake any Electrical Engineering course at the 300-level or below in which they receive a grade below a C (2.000).

## Requirements Effective Fall 2024

In order to maintain professional standards required of practicing engineers, the Department of Electrical and Computer Engineering

### Freshman

		AUCC	Credits
BIOM 100	Overview of Biomedical Engineering		1
CHEM 111	General Chemistry I (GT-SC2)	3A	4
CO 150	College Composition (GT-CO2)	1A	3
ECE 102	Digital Circuit Logic		4
ECE 103	DC Circuit Analysis		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
PH 141	Physics for Scientists and Engineers I (GT-SC1)	3A	5
<b>Total Credits</b>			<b>32</b>

### Sophomore

BIOM 200	Fundamentals of Biomedical Engineering		2
CHEM 112	General Chemistry Lab I (GT-SC1)	3A	1
Select from one of the following groups: <sup>1</sup>			3-4
Group A			
CS 150B	Culture and Coding: Python (GT-AH3)	3B	
Group B			
CS 152	Python for STEM		
CS 162	CS1—Introduction to Java Programming		
Group C			
CS 163	CS1—No Prior Programming Experience		
ECE 202	Circuit Theory Applications		4
ECE 232	Introduction to Project Practices		1
<b>ECE 303/STAT 303</b>	<b>Introduction to Communications Principles</b>		<b>3</b>
MATH 261	Calculus for Physical Scientists III		4
MATH 340	Intro to Ordinary Differential Equations		4
PH 142	Physics for Scientists and Engineers II (GT-SC1)	3A	5
PH 314	Introduction to Modern Physics		4
<b>Total Credits</b>			<b>31-32</b>

### Junior

BIOM 300	Problem-Based Learning Biomedical Engr Lab		4
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BMS 300	Principles of Human Physiology		4
Select from the following to complete group sequence: <sup>1</sup>			3-4
Group A			
CS 164	CS1--Computational Thinking with Java		
Group B			
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	
Group C			
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	
ECE 311	Linear System Analysis I		3
ECE 331	Electronics Principles I		4
ECE 332	Electronics Principles II		4
ECE 341	Electromagnetic Fields and Devices I		3
ECE 342	Electromagnetic Fields and Devices II		3
<b>Total Credits</b>			<b>28-29</b>

**Senior**

<b>BIOM 431/ECE 431</b>	<b>Biomedical Signal and Image Processing</b>		<b>3</b>
CHEM 113	General Chemistry II		3
CHEM 245	Fundamentals of Organic Chemistry		4
ECE 404	Experiments in Optical Electronics		2
ECE 441	Optical Electronics		3
ECE 457	Fourier Optics		3
ECON 202	Principles of Microeconomics (GT-SS1)	3C	3
MECH 262	Engineering Mechanics		4
MECH 337	Thermodynamics		4
PH 353	Optics and Waves		4
<b>Total Credits</b>			<b>33</b>

**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
PH 451	Introductory Quantum Mechanics I		3
Select one course from the following:			3
CO 301B	Writing in the Disciplines: Sciences (GT-CO3)	2	
JTC 300	Strategic Writing and Communication (GT-CO3)	2	
ECE Lasers & Optical Engineering Technical Electives (See list below)			8
BME Broad Elective (see list below)			3
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
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
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>34</b>

**Program Total Credits: 158-160**

**ECE Lasers & Optical Engineering Technical Electives List – Select 9 credits**

Code	Title	Credits
BIOM 403/ECE 403	Intro to Optical Techniques in Biomedical Eng	3
ECE 312	Linear System Analysis II	3

ECE 415	Semiconductor Physics and Junctions	2
A maximum of 3 credits from the following may be used to satisfy this requirement:		
ECE 495A	Independent Study	var.
ECE 495B	Independent Study: Open Option Project	

ECE 495C	Independent Study: Vertically Integrated Projects		BIOM 350B	Study Abroad--Portugal: Biomedical Engineering and Healthcare	1
ECE 503	Ultrafast Optics	3	BIOM 421	Transport Phenomena in Biomedical Engineering	3
ECE 504	Physical Optics	3	BIOM 422	Quantitative Systems and Synthetic Biology	3
ECE 505	Nanostructures Fundamentals and Applications	3	BIOM 441	Biomechanics and Biomaterials	3
ECE 506	Optical Interferometry and Laser Metrology	3	BIOM 504/CBE 504	Fundamentals of Biochemical Engineering	3
ECE 507	Plasma Physics and Applications	3	BIOM 517/ECE 517	Advanced Optical Imaging	3
ECE 526/BIOM 526	Biological Physics	3	BIOM 518/ECE 518	Biophotonics	3
ECE 527B/ BIOM 527B	Biosensing: Signal and Noise in Biosensors	1	BIOM 522/CBE 522	Bioseparation Processes	3
ECE 527F/ BIOM 527F	Biosensing: Biophotonic Sensors Using Refractive Index	1	BIOM 525/MECH 525	Cell and Tissue Engineering	3
ECE 544	Silicon Photonics for Computing Systems	3	BIOM 526/ECE 526	Biological Physics	3
ECE 546	Laser Fundamentals and Devices	3	BIOM 527A/ ECE 527A	Biosensing: Cells as Circuits	1
ECE 572	Semiconductor Transistors	1	BIOM 527B/ ECE 527B	Biosensing: Signal and Noise in Biosensors	1
ECE 573	Semiconductor Optoelectronics Laboratory	3	BIOM 527C/ ECE 527C	Biosensing: Sensor Circuit Fundamentals	1
ECE 574	Optical Properties in Solids	3	BIOM 527D/ ECE 527D	Biosensing: Electrochemical Sensors	1
MATH 419	Introduction to Complex Variables	3	BIOM 527E/ ECE 527E	Biosensing: Affinity Sensors	1
MATH 430/ECE 430	Fourier and Wavelet Analysis with Apps	3	BIOM 527F/ ECE 527F	Biosensing: Biophotonic Sensors Using Refractive Index	1
PH 315	Modern Physics Laboratory	2	BIOM 531/MECH 531	Materials Engineering	3
PH 425	Advanced Physics Laboratory	2	BIOM 532/MECH 532	Materials Issues in Mechanical Design	3
PH 452	Introductory Quantum Mechanics II	3	BIOM 533/CIVE 533	Biomolecular Tools for Engineers	3
PH 462	Statistical Physics	3	BIOM 537/ECE 537	Biomedical Signal Processing	3

### BME Broad Electives - Select 3 credits

Code	Title	Credits			
AB 410	Understanding Pesticides	3	BIOM 570/MECH 570	Bioengineering	3
ATS 550	Atmospheric Radiation and Remote Sensing	3	BIOM 572/MECH 572	Regenerative Bioengineering with Stem Cells	3
ATS 555	Air Pollution	3	BIOM 573/MECH 573	Structure and Function of Biomaterials	3
ATS 560	Air Pollution Measurement	2	BIOM 574/MECH 574	Bio-Inspired Surfaces	3
BC 351	Principles of Biochemistry	4	BIOM 576/MECH 576	Quantitative Systems Physiology	4
BC 401	Comprehensive Biochemistry I	3	BIOM 578/MECH 578	Musculoskeletal Biosolid Mechanics	3
BC 403	Comprehensive Biochemistry II	3	BIOM 579/MECH 579	Cardiovascular Biomechanics	3
BC 404	Comprehensive Biochemistry Laboratory	2	BMS 301	Human Gross Anatomy	5
BC 406A	Investigative Biochemistry: Protein Biochemistry	2	BMS 302	Laboratory in Principles of Physiology	2
BC 406B	Investigative Biochemistry: Molecular Genetics	2	BMS 305	Domestic Animal Gross Anatomy	4
BC 406C	Investigative Biochemistry: Cellular Biochemistry	2	BMS 310	Anatomy for the Health Professions	4
BC 411	Physical Biochemistry	4	BMS 320	Virtual Laboratory in Physiology	2
BC 441	3D Molecular Models for Biochemistry	1	BMS 325	Cellular Neurobiology	3
BC 463	Molecular Genetics	3	BMS 330	Microscopic Anatomy	4
BC 464	Molecular Genetics Recitation	1	BMS 345	Functional Neuroanatomy	4
BC 465	Molecular Regulation of Cell Function	3	BMS 405	Nerve and Muscle-Toxins, Trauma and Disease	3
BC 517	Metabolism	2	BMS 409	Human and Animal Reproductive Biology	3
BC 521/CHEM 521	Principles of Chemical Biology	3	BMS 420	Cardiopulmonary Physiology	3
BC 563	Molecular Genetics	4	BMS 430	Endocrinology	3
BIOM 304	Global Challenges and Collaborations in BME	3	BMS 450	Pharmacology	3
BIOM 350A	Study Abroad--Ecuador: Prosthetics	1-3	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	CHEM 445	Synthetic Organic Chemistry	3
BMS 505/NB 505	Neuronal Circuits, Systems and Behavior	3	CHEM 448	Medicinal Chemistry	3
BMS 545	Neuroanatomy	5	CHEM 451	Foundations of Catalytic Chemistry	3
BMS 575	Human Anatomy Dissection	4	CHEM 461	Inorganic Chemistry	3
BSPM 302	Applied and General Entomology	2	CHEM 462	Inorganic Chemistry Laboratory	2
BSPM 361	Elements of Plant Pathology	3	CHEM 465	Chemistry of Sustainable E-Waste Management	1
BZ 240	Synthetic Biology-Principles and Applications	3	CHEM 522	Methods of Chemical Biology	2
BZ 310	Cell Biology	4	CHEM 532	Advanced Chemical Analysis II	3
BZ 311	Developmental Biology	4	CHEM 537	Electrochemical Methods	3
BZ 348/MATH 348	Theory of Population and Evolutionary Ecology	4	CHEM 539A	Principles of NMR and MRI: Basic NMR Principles	1
BZ 350	Molecular and General Genetics	4	CHEM 539B	Principles of NMR and MRI: NMR Diffusion Measurements-2D NMR and MRI	1
BZ 360	Bioinformatics and Genomics	4	CHEM 539C	Principles of NMR and MRI: Advanced NMR and MRI Techniques	1
BZ 420	Evolutionary Medicine	3	CHEM 541	Organic Molecular Structure Determination	2
BZ 476/BZ 576	Genetics of Model Organisms	3	CHEM 543	Structure/Mechanisms in Organic Chemistry	2
CBE 330	Process Simulation	3	CHEM 545	Synthetic Organic Chemistry I	3
CBE 406	Introduction to Transport Phenomena	3	CHEM 547	Physical Organic Chemistry	3
CBE 501	Chemical Engineering Thermodynamics	3	CHEM 555	Chemistry of Sustainability	3
CBE 502	Advanced Reactor Design	3	CHEM 560	Foundations of Inorganic Synthesis	1
CBE 503	Transport Phenomena Fundamentals	3	CHEM 566	Bioinorganic Chemistry	3
CBE 505	Biochemical Engineering Laboratory	1	CHEM 567	Crystallographic Computation	1
CBE 514	Polymer Science and Engineering	3	CHEM 569	Chemical Crystallography	3
CBE 521	Mathematical Modeling for Chemical Engineers	3	CHEM 570	Chemical Bonding	3
CBE 524	Bioremediation	1	CHEM 575	Fundamentals of Chemical Thermodynamics	1
CBE 540/CIVE 540	Advanced Biological Wastewater Processing	3	CHEM 576	Statistical Mechanics	2
CBE 560	Engineering of Protein Expression Systems	3	CHEM 577	Surface Chemistry	3
CBE 570	Biomolecular Engineering/Synthetic Biology	3	CHEM 578A	Computational Chemistry: Electronic Structure	1
CHEM 231	Foundations of Analytical Chemistry	3	CHEM 579	Chemical Kinetics	3
CHEM 232	Foundations of Analytical Chemistry Lab	2	CIVE 322	Basic Hydrology	3
CHEM 246	Fundamentals of Organic Chemistry Laboratory	1	CIVE 330	Ecological Engineering	3
CHEM 261	Fundamentals of Inorganic Chemistry	3	CIVE 360	Mechanics of Solids	3
CHEM 263	Foundations of Inorganic Chemistry	4	CIVE 367	Structural Analysis	3
CHEM 264	Foundations of Inorganic Chemistry Laboratory	1	CIVE 371	Study Abroad--Peru: Grand Challenges in Engineering in Peru	3
CHEM 311	Introduction to Nanoscale Science	3	CIVE 401	Hydraulic Engineering	3
CHEM 315	Foundations of Polymer Chemistry	3	CIVE 423	Groundwater Engineering	3
CHEM 320	Chemistry of Addictions	3	CIVE 438	Fundamentals of Environmental Engr	3
CHEM 333	Forensic Chemistry	3	CIVE 439	Applications of Environmental Engr Concepts	3
CHEM 334	Quantitative Analysis Laboratory	1	CIVE 440	Nonpoint Source Pollution	3
CHEM 335	Introduction to Analytical Chemistry	3	CIVE 442	Air Quality Engineering	3
CHEM 338	Environmental Chemistry	3	CIVE 515	River Mechanics	3
CHEM 343	Modern Organic Chemistry II	3	CIVE 520	Physical Hydrology	3
CHEM 344	Modern Organic Chemistry Laboratory	2	CIVE 524/WR 524	Modeling Watershed Hydrology	3
CHEM 346	Organic Chemistry II	4	CIVE 531	Groundwater Hydrology	3
CHEM 355	Foundations of Sustainable Chemistry	3	CIVE 538	Aqueous Chemistry	3
CHEM 431	Instrumental Analysis	4	CIVE 560	Advanced Mechanics of Materials	3
CHEM 433	Clinical Chemistry	3	CIVE 562	Fundamentals of Vibrations	3
CHEM 440	Advanced Organic Chemistry Laboratory	2			

CS 164	CS1--Computational Thinking with Java	4	ESS 353	Global Change Impacts, Adaptation, Mitigation	3
CS 165	CS2--Data Structures	4	ESS 440	Practicing Sustainability	4
CS 220	Discrete Structures and their Applications	4	ESS 501	Principles of Ecosystem Sustainability	3
CS 253	Software Development with C++	4	ESS 524	Foundations for Carbon/Greenhouse Gas Mgmt	3
CS 270	Computer Organization	4	F 311	Forest Ecology	3
CS 314	Software Engineering	3	FIN 305	Fundamentals of Finance	3
CS 320	Algorithms--Theory and Practice	3	FSHN 470	Integrative Nutrition and Metabolism	3
CS 356	Systems Security	3	FTEC 447	Food Chemistry	3
CS 370	Operating Systems	3	GEOL 150	Dynamic Earth (GT-SC2)	4
CS 4** - Any 400-level CS course except CS 495			GEOL 452	Hydrogeology	4
CS 5** - Any 500-level CS course			GEOL 454	Geomorphology	4
DSCI 320	Optimization Methods in Data Science	3	GES 362	Systems Thinking and Sustainability	3
DSCI 369	Linear Algebra for Data Science (credit not allowed for both DSCI 369 and MATH 369)	3-4	GES 441	Analysis of Sustainable Energy Solutions	3
or MATH 369	Linear Algebra I		GES 450	Global Sustainability and Health	3
ECE 312	Linear System Analysis II	3	GES 465/MSE 465	Sustainable Strategies for E-Waste Management	3
ECE 4** - Any ECE course at the 400-level except ECE 495			GES 528/CIVE 528	Assessing the Food, Energy, Water Nexus	3
ECE 5** - Any ECE course at the 500-level			GES 542	Biobased Fuels, Energy, and Chemicals	3
ENGR 300	3D Printing Lab for Engineers	1	GR 305	Geography of Global Health	3
ENGR 422	Technology Entrepreneurship	3	HES 207	Anatomical Kinesiology	4
ENGR 478	Applied Engineering Data Analytics	3	HES 307	Biomechanical Principles of Human Movement	3
ENGR 502	Engineering Project and Program Management	3	HES 319	Neuromuscular Aspects of Human Movement	4
ENGR 510	Engineering Optimization: Method/ Application	3	HES 345	Population Health and Disease Prevention	3
ENGR 525	Intellectual Property and Invention Systems	3	HES 403	Physiology of Exercise	3
ENGR 531	Engineering Risk Analysis	3	HES 420	Electrocardiography and Exercise Management	3
ENGR 550/ MATH 550	Numerical Methods in Science and Engineering	3	HES 476	Exercise and Chronic Disease	3
ENGR 570	Coupled Electromechanical Systems	3	HORT 579	Mass Spectrometry Omics-Methods and Analysis	3
ERHS 320	Environmental Health--Water Quality	3	IDEA 310B	Design Thinking Toolbox: 3D Modeling	2
ERHS 332	Principles of Epidemiology	3	IDEA 310D	Design Thinking Toolbox: Digital Imaging	1
ERHS 400	Radiation Safety	3	IDEA 310H/CS 310H	Design Thinking Toolbox: Mixed Reality Design	3
ERHS 410	Environmental Health-Air and Waste Management	3	IDEA 455/MGT 455	Designing for Defense	3
ERHS 430	Human Disease and the Environment	3	LIFE 201B	Introductory Genetics: Molecular/ Immunological/Developmental (GT-SC2)	3
ERHS 446	Environmental Toxicology	3	LIFE 202B	Introductory Genetics Recitation: Molecular	1
ERHS 448	Environmental Contaminants	3	LIFE 203	Introductory Genetics Laboratory	2
ERHS 450	Introduction to Radiation Biology	3	LIFE 210	Introductory Eukaryotic Cell Biology	3
ERHS 502	Fundamentals of Toxicology	3	LIFE 211	Introductory Cell Biology Honors Recitation	1
ERHS 503	Toxicology Principles	1	LIFE 212	Introductory Cell Biology Laboratory	2
ERHS 510/VS 510	Cancer Biology	3	LIFE 320	Ecology	3
ERHS 530	Radiological Physics and Dosimetry I	3	LSPA 340	Spanish for Animal Health and Care Fields	3
ERHS 540	Principles of Ergonomics	3	LSPA 346	Spanish for Health Care	3
ERHS 542	Biostatistical Methods for Qualitative Data	3	MATH 151	Mathematical Algorithms in Matlab I	1
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

MATH 332	Partial Differential Equations	3	MIP 420	Medical and Molecular Virology	4
MATH 360	Mathematics of Information Security	3	MIP 425	Virology and Cell Culture Laboratory	2
MATH 366	Introduction to Abstract Algebra	3	MIP 432/ESS 432	Microbial Ecology	3
MATH 405	Introduction to Number Theory	3	MIP 433/ESS 433	Microbial Ecology Laboratory	1
MATH 417	Advanced Calculus I	3	MIP 443	Microbial Physiology	4
MATH 418	Advanced Calculus II	3	MIP 450	Microbial Genetics	3
MATH 419	Introduction to Complex Variables	3	MIP 530	Advanced Molecular Virology	4
MATH 430/ECE 430	Fourier and Wavelet Analysis with Apps	3	MIP 543	RNA Biology	3
MATH 450	Introduction to Numerical Analysis I	3	MIP 550	Microbial and Molecular Genetics Laboratory	4
MATH 451	Introduction to Numerical Analysis II	3	MIP 555	Principles and Mechanisms of Disease	3
MATH 455	Mathematics in Biology and Medicine	3	MKT 305	Fundamentals of Marketing	3
MATH 460	Information and Coding Theory	3	MSE 501	Materials Technology Transfer	1
MATH 463	Post-Quantum Cryptography	3	MSE 502A	Materials Science and Engineering Methods: Materials Structure and Scattering	1
MATH 466	Abstract Algebra I	3	MSE 502B	Materials Science and Engineering Methods: Computational Materials Methods	1
MATH 467	Abstract Algebra II	3	MSE 502C	Materials Science and Engineering Methods: Materials Microscopy	1
MATH 469	Linear Algebra II	3	MSE 502D	Materials Science and Engineering Methods: Materials Spectroscopy	1
MATH 470	Euclidean and Non-Euclidean Geometry	3	MSE 502E	Materials Science and Engineering Methods: Bulk Properties and Performance	1
MATH 474	Introduction to Differential Geometry	3	MSE 502F	Materials Science and Engineering Methods: Experimental Methods for Materials Research	1
MATH 525	Optimal Control	3	MSE 503	Mechanical Behavior of Materials	3
MATH 530	Mathematics for Scientists and Engineers	3	MSE 504	Thermodynamics of Materials	3
MATH 532	Mathematical Modeling of Large Data Sets	3	MSE 505	Kinetics of Materials	3
MATH 535	Foundations of Applied Mathematics	3	NR 319	Introduction to Geospatial Science	4
MATH 546	Partial Differential Equations II	3	NR 323/GR 323	Remote Sensing and Image Interpretation	3
MATH 550/ENGR 550	Numerical Methods in Science and Engineering	3	NR 505	Concepts in GIS	4
MATH 560	Linear Algebra	3	PH 314	Introduction to Modern Physics	4
MATH 569A	Linear Algebra for Data Science: Matrices and Vectors Spaces	1	PH 315	Modern Physics Laboratory	2
MATH 569B	Linear Algebra for Data Science: Geometric Techniques for Data Reduction	1	PH 341	Mechanics	4
MATH 569C	Linear Algebra for Data Science: Matrix Factorizations and Transformations	1	PH 351	Electricity and Magnetism	4
MATH 569D	Linear Algebra for Data Science: Theoretical Foundations	1	PH 353	Optics and Waves	4
MECH 200	Introduction to Manufacturing Processes	3	PH 361	Physical Thermodynamics	3
MECH 307	Mechatronics and Measurement Systems	4	PH 425	Advanced Physics Laboratory	2
MECH 324	Dynamics of Machines	4	PH 451	Introductory Quantum Mechanics I	3
MECH 325	Machine Design	3	PH 452	Introductory Quantum Mechanics II	3
MECH 331	Introduction to Engineering Materials	4	PH 462	Statistical Physics	3
MECH 4** - Any 400-level MECH Course except MECH 495			PH 517	Chaos, Fractals, and Nonlinear Dynamics	3
MECH 5** - Any 500-level course			PH 521	Introduction to Lasers	3
MGT 305	Fundamentals of Management	3	PH 522	Introductory Laser Laboratory	1
MGT 340	Fundamentals of Entrepreneurship	3	PH 531	Introductory Condensed Matter Physics	3
MIP 300	General Microbiology	3	PH 561	Elementary Particle Physics	3
MIP 302	General Microbiology Laboratory	2	PH 571	Mathematical Methods for Physics I	3
MIP 315	Pathology of Human and Animal Disease	3	PHIL 322	Biomedical Ethics	3
MIP 334	Food Microbiology	3	PHIL 410	Gödel's Incompleteness Theorems	3
MIP 335	Food Microbiology Laboratory	2	PSY 253	Human Factors and Engineering Psychology	3
MIP 342	Immunology	4			
MIP 343	Immunology Laboratory	2			
MIP 351	Medical Bacteriology	3			
MIP 352	Medical Bacteriology Laboratory	3			
MIP 410	Foundations of Modern Biotechnology	2			

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
SPCM 434	Intercultural Communication	3
STAR 512	Design and Data Analysis for Researchers II	4
STAT 158	Introduction to R Programming	1
STAT 305	Sampling Techniques	3
STAT 307	Introduction to Biostatistics	3
STAT 331	Intermediate Applied Statistical Methods	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 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

<sup>1</sup> Students must take a total of 7 credits from either of these groups: Group A: CS 150B + CS 164 - OR - Group B: AUCC 3B + CS 163 - OR - Group C: AUCC 3B + CS 152 + CS 162. Recommended sequence for most incoming students is Group A: **CS 150B to CS 164**.

## Major Completion Map

### Distinctive Requirements for Degree Program:

**TO DECLARE MAJOR:** Engineering is a controlled major: students are admitted into the major only if they meet established academic standards. Please see competitive major requirements or the advisor in the department for more information.

**TO PREPARE FOR FIRST SEMESTER:** The curriculum for this major assumes students enter college prepared to take calculus and chemistry.

To qualify for graduation, students in the biomedical engineering combined with chemical and biological engineering program must achieve a minimum 2.000 grade point average at CSU in all courses in engineering, mathematics, computer science, statistics, physics, and chemistry as well as courses taken as technical electives.

**In order to maintain professional standards required of practicing engineers, the Department of Electrical and Computer Engineering requires a cumulative grade point average of at least 2.000 in ECE courses as a graduation requirement. It is the responsibility of any student who fails to maintain a 2.000 average to work with their advisor to correct grade point deficiencies. In addition, it is required that students retake any Electrical Engineering course at the 300-level or below in which they receive a grade below a C (2.000).**

### Freshman

Semester 1		Critical	Recommended	AUCC	Credits
BIOM 100	Overview of Biomedical Engineering	X			1
CHEM 111	General Chemistry I (GT-SC2)	X		3A	4
CO 150	College Composition (GT-CO2)		X	1A	3
ECE 102	Digital Circuit Logic	X			4
MATH 160	Calculus for Physical Scientists I (GT-MA1)	X		1B	4

**Total Credits 16**

Semester 2		Critical	Recommended	AUCC	Credits
ECE 103	DC Circuit Analysis	X			3
LIFE 102	Attributes of Living Systems (GT-SC1)	X		3A	4
MATH 161	Calculus for Physical Scientists II (GT-MA1)	X		1B	4
PH 141	Physics for Scientists and Engineers I (GT-SC1)	X		3A	5

**Total Credits 16**

### Sophomore

Semester 3		Critical	Recommended	AUCC	Credits
BIOM 200	Fundamentals of Biomedical Engineering	X			2
CHEM 112	General Chemistry Lab I (GT-SC1)		X	3A	1
Select from one of the following groups:		X			3-4
Group A					
CS 150B	Culture and Coding: Python (GT-AH3)	X		3B,3B	
Group B					

CS 152	Python for STEM	X			
CS 162	CS1--Introduction to Java Programming	X			
<b>Group C</b>					
CS 163	CS1--No Prior Programming Experience	X			
MATH 261	Calculus for Physical Scientists III	X			4
PH 142	Physics for Scientists and Engineers II (GT-SC1)	X		3A	5
<b>Total Credits</b>					<b>15-16</b>
<b>Semester 4</b>		<b>Critical</b>	<b>Recommended</b>	<b>AUCC</b>	<b>Credits</b>
ECE 202	Circuit Theory Applications	X			4
ECE 232	Introduction to Project Practices	X			1
<b>ECE 303/ STAT 303</b>	<b>Introduction to Communications Principles</b>	<b>X</b>			<b>3</b>
MATH 340	Intro to Ordinary Differential Equations	X			4
PH 314	Introduction to Modern Physics	X			4
<b>Total Credits</b>					<b>16</b>
<b>Junior</b>					
<b>Semester 5</b>		<b>Critical</b>	<b>Recommended</b>	<b>AUCC</b>	<b>Credits</b>
ECE 311	Linear System Analysis I	X			3
ECE 331	Electronics Principles I	X			4
ECE 341	Electromagnetic Fields and Devices I	X			3
Select from the following to complete group sequence:					3-4
<b>Group A</b>					
CS 164	CS1--Computational Thinking with Java	X			
<b>Group B</b>					
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> )		X		3B	
<b>Group C</b>					
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> )		X		3B	
<b>Total Credits</b>					<b>13-14</b>
<b>Semester 6</b>		<b>Critical</b>	<b>Recommended</b>	<b>AUCC</b>	<b>Credits</b>
BIOM 300	Problem-Based Learning Biomedical Engr Lab	X			4
BMS 300	Principles of Human Physiology		X		4
ECE 332	Electronics Principles II	X			4
ECE 342	Electromagnetic Fields and Devices II	X			3
<b>Total Credits</b>					<b>15</b>
<b>Senior</b>					
<b>Semester 7</b>		<b>Critical</b>	<b>Recommended</b>	<b>AUCC</b>	<b>Credits</b>
CHEM 113	General Chemistry II		X		3
ECE 404	Experiments in Optical Electronics	X			2
ECE 441	Optical Electronics	X			3
MECH 337	Thermodynamics		X		4
PH 353	Optics and Waves	X			4
<b>Total Credits</b>					<b>16</b>
<b>Semester 8</b>		<b>Critical</b>	<b>Recommended</b>	<b>AUCC</b>	<b>Credits</b>
<b>BIOM 431/ ECE 431</b>	<b>Biomedical Signal and Image Processing</b>	<b>X</b>			<b>3</b>
CHEM 245	Fundamentals of Organic Chemistry		X		4
ECE 457	Fourier Optics	X			3
ECON 202	Principles of Microeconomics (GT-SS1)		X	3C	3
MECH 262	Engineering Mechanics	X			4
<b>Total Credits</b>					<b>17</b>

**Fifth Year**

<b>Semester 9</b>		<b>Critical</b>	<b>Recommended</b>	<b>AUCC</b>	<b>Credits</b>
BIOM 486A	Biomedical Design Practicum: Capstone Design I	X		4A,4B,4C	4
PH 451	Introductory Quantum Mechanics I	X			3
Select one course from the following:			X		3
CO 301B	Writing in the Disciplines: Sciences (GT-CO3)			2	
JTC 300	Strategic Writing and Communication (GT-CO3)		X	2	
ECE Lasers & Optical Engineering Technical Electives (See List on Requirements tab)			X		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> )			X	1C	3

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**Total Credits** **17**

<b>Semester 10</b>		<b>Critical</b>	<b>Recommended</b>	<b>AUCC</b>	<b>Credits</b>
BIOM 486B	Biomedical Design Practicum: Capstone Design II	X		4A,4B,4C	4
BME Broad Elective (See List on Requirements Tab)		X			3
ECE Lasers & Optical Engineering Technical Electives (See List on Requirements tab)		X			4
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> )		X		3B	3
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> )		X		3D	3
The benchmark courses for the 10th semester are the remaining courses in the entire program of study.		X			

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**Total Credits** **17**

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**Program Total Credits:** **158-160**