

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 (https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#social-behavioral-sciences) | | 3C | 3 |
| Total Credits | | | 29 |

Sophomore

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|----------------------|---|----|-----------|
| 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 |
| Total Credits | | | 30 |

Junior

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| 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 (https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities) | | 3 |

Total Credits **32**

Senior

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|---|--|------|
| 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 (https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#advanced-writing) | | 2 3 |
| Historical Perspectives (https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#historical-perspectives) | | 3D 3 |

Total Credits **35**

Fifth Year

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|---|---|----------|---|
| 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 (https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#aucc) | | 1C | 3 |
| Arts and Humanities (https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities) | | 3B | 3 |

Total Credits **31**

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 |

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| 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 CreditsSelect 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 |

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|-------------------|---|-----|------------------------|---|---|
| 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 | | | |

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| 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 |

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|-----------------|--|---|--|---|----------------|
| 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 | Chemistry Electives - Select 6 Credits | | |
| PH 353 | Optics and Waves | 4 | Code | Title | Credits |
| 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 |

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|------------------|--|---|--|---|-----|
| 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 Addictions | 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 |

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|-----------------------|---|---|-------------------------|--|---|
| 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 |

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|--|--|---|---------------|---|---|
| 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 |

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|------------------|---|---|---|
| SYSE 530 | Overview of Systems Engineering Processes | 3 | standards. Please see competitive major requirements or the advisor in the Department for more information. |
| SYSE 532/ECE 532 | Dynamics of Complex Engineering Systems | 3 | 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. |
| SYSE 534 | Human Systems Integration | 3 | |
| VS 333 | Domestic Animal Anatomy | 4 | |

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

Freshman

| Semester 1 | | Critical | Recommended | AUCC | Credits |
|--------------------------------------|---|----------|-------------|------|---------|
| CHEM 120 | Foundations of Modern Chemistry (GT-SC2) | X | | 3A | 4 |
| CHEM 121 | Foundations of Modern Chemistry Laboratory (GT-SC1) | X | | 3A | 1 |
| CO 150 | College Composition (GT-CO2) | X | | 1A | 3 |
| MATH 160 | Calculus for Physical Scientists I (GT-MA1) | X | | 1B | 4 |
| Select one Group from the Following: | | | | | 3 |
| Group A: | | | | | |
| ENGR 111 | Fundamentals of Engineering | X | | | |
| Group B: | | | | | |
| CBE 101 | Introduction to Chemical and Biological Engr | X | | | |
| Group C: | | | | | |
| CBE 101A | Introduction to Chemical and Biological Engr: Lecture | X | | | |
| CBE 101B | Introduction to Chemical and Biological Engr: Laboratory | X | | | |
| CBE 160 | MATLAB for Chemical and Biological Eng | X | | | |
| Group D: | | | | | |
| CBE 104A | Study Abroad--Denmark: Intro to Chemical and Biological Engineering | X | | | |

Total Credits **15**

| Semester 2 | | Critical | Recommended | AUCC | Credits | |
|--|--|----------|-------------|------|---------|---|
| ENGR 114 | Engineering for Grand Challenges | 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 | |
| Social and Behavioral Sciences (https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#social-behavioral-sciences) | | | | X | 3C | 3 |

Total Credits **14**

Sophomore

| Semester 3 | | Critical | Recommended | AUCC | Credits |
|------------|---|----------|-------------|------|---------|
| CBE 201 | Material and Energy Balances | X | | | 3 |
| CBE 205 | Fundamentals of Biological Engineering | X | | | 3 |
| MATH 261 | Calculus for Physical Scientists III | X | | | 4 |
| PH 141 | Physics for Scientists and Engineers I (GT-SC1) | X | | 3A | 5 |

Total Credits **15**

| Semester 4 | | Critical | Recommended | AUCC | Credits |
|------------|---|----------|-------------|------|---------|
| CBE 210 | Thermodynamic Process Analysis | X | | | 3 |
| CBE 223 | CBE Design and Experimentation I | X | | | 2 |
| CHEM 241 | Foundations of Organic Chemistry | X | | | 4 |
| CHEM 242 | Foundations of Organic Chemistry Laboratory | X | | | 1 |
| CBE 393 | Professional Development Seminar | X | | | 1 |
| MATH 340 | Intro to Ordinary Differential Equations | X | | | 4 |

Total Credits **15**

Junior

| Semester 5 | | Critical | Recommended | AUCC | Credits |
|---|--|-----------------|--------------------|-------------|----------------|
| CBE 320 | Chemical and Biological Reactor Design | X | | | 3 |
| CBE 330 | Process Simulation | X | | | 3 |
| CBE 331 | Momentum Transfer and Mechanical Separations | X | | | 3 |
| CBE 334 | CBE Design and Experimentation II | X | | | 1 |
| Select one of the following courses: | | | | | 4 |
| BC 351 | Principles of Biochemistry | | X | | |
| BMS 300 | Principles of Human Physiology | | X | | |
| Arts and Humanities (https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities) | | | X | 3B | 3 |
| Total Credits | | | | | 17 |

| Semester 6 | | Critical | Recommended | AUCC | Credits |
|----------------------|--|-----------------|--------------------|-------------|----------------|
| BIOM 300 | Problem-Based Learning Biomedical Engr Lab | X | | | 4 |
| CBE 332 | Heat and Mass Transfer Fundamentals | X | | | 3 |
| CBE 335 | CBE Design and Experimentation III | X | | | 1 |
| CBE 340 | Statistics for CBE Applications | X | | | 3 |
| MECH 262 | Engineering Mechanics | X | | | 4 |
| Total Credits | | | | | 15 |

Senior

| Semester 7 | | Critical | Recommended | AUCC | Credits |
|---|--|-----------------|--------------------|-------------|----------------|
| BIOM 422 | Quantitative Systems and Synthetic Biology | X | | | 3 |
| CBE 442 | Separation Processes | X | | | 4 |
| CBE 443 | Chemical and Biological Engineering Lab II | X | | | 2 |
| CBE 451 | Chemical and Biological Engineering Design I | X | | | 3 |
| BME Broad Elective (See List on Requirements Tab) | | | X | | 3 |
| Historical Perspectives (https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#historical-perspectives) | | | X | 3D | 3 |
| Total Credits | | | | | 18 |

| Semester 8 | | Critical | Recommended | AUCC | Credits |
|--|--|-----------------|--------------------|-------------|----------------|
| BIOM 421 | Transport Phenomena in Biomedical Engineering | | | | 3 |
| CBE 430 | Process Control and Instrumentation | X | | | 3 |
| PH 142 | Physics for Scientists and Engineers II (GT-SC1) | | X | 3A | 5 |
| Chemistry Elective (See List on Requirements Tab) | | | X | | 3 |
| Advanced Writing (https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#advanced-writing) | | | X | 2 | 3 |
| Total Credits | | | | | 17 |

| Semester 9 | | Critical | Recommended | AUCC | Credits |
|--|--|-----------------|--------------------|-------------|----------------|
| BIOM 486A | Biomedical Design Practicum: Capstone Design I | X | | 4A,4B,4C | 4 |
| Select one of the following courses (one that you have not taken previously): | | | | | 4 |
| BC 351 | Principles of Biochemistry | X | | | |
| BMS 300 | Principles of Human Physiology | X | | | |
| BME Technical Elective (See List on Requirements Tab) | | | X | | 3 |
| CBE Technical Elective (See List on Requirements Tab) | | | X | | 2 |
| 1C (https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#aucc) | | | X | 1C | 3 |
| Total Credits | | | | | 16 |

| Semester 10 | | Critical | Recommended | AUCC | Credits |
|---|---|-----------------|--------------------|-------------|----------------|
| BIOM 486B | Biomedical Design Practicum: Capstone Design II | X | | 4A,4B,4C | 4 |
| BME Technical Elective (See List on Requirements Tab) | | | X | | 2 |
| CBE Technical Elective (See List on Requirements Tab) | | | X | | 3 |
| Chemistry Elective (See List on Requirements Tab) | | | X | | 3 |

| | | | |
|---|---|----|------------|
| Arts and Humanities (https://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities) | X | 3B | 3 |
| The benchmark courses for the 10th semester are the remaining courses in the entire program of study | X | | |
| Total Credits | | | 15 |
| Program Total Credits: | | | 157 |