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

Requirements
Effective Fall 2022

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

Freshman

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>AUCC</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOM 100</td>
<td>Overview of Biomedical Engineering</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>CHEM 111</td>
<td>General Chemistry I (GT-SC2)</td>
<td>3A</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 112</td>
<td>General Chemistry Lab I (GT-SC1)</td>
<td>3A</td>
<td>1</td>
</tr>
<tr>
<td>CO 150</td>
<td>College Composition (GT-CO2)</td>
<td>1A</td>
<td>3</td>
</tr>
<tr>
<td>ECE 102</td>
<td>Digital Circuit Logic</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>ECE 103</td>
<td>DC Circuit Analysis</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>LIFE 102</td>
<td>Attributes of Living Systems (GT-SC1)</td>
<td>3A</td>
<td>4</td>
</tr>
<tr>
<td>MATH 160</td>
<td>Calculus for Physical Scientists I (GT-MA1)</td>
<td>1B</td>
<td>4</td>
</tr>
<tr>
<td>MATH 161</td>
<td>Calculus for Physical Scientists II (GT-MA1)</td>
<td>1B</td>
<td>4</td>
</tr>
<tr>
<td>PH 141</td>
<td>Physics for Scientists and Engineers I (GT-SC1)</td>
<td>3A</td>
<td>5</td>
</tr>
</tbody>
</table>

Career Development Seminar

Total Credits 33

Sophomore

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>AUCC</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOM 200</td>
<td>Fundamentals of Biomedical Engineering</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>ECE 202</td>
<td>Circuit Theory Applications</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>ECE 232</td>
<td>Introduction to Project Practices</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>ECE 303/STAT 303</td>
<td>Introduction to Communications Principles</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>MATH 261</td>
<td>Calculus for Physical Scientists III</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>MATH 340</td>
<td>Intro to Ordinary Differential Equations</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>PH 142</td>
<td>Physics for Scientists and Engineers II (GT-SC1)</td>
<td>3A</td>
<td>5</td>
</tr>
<tr>
<td>PH 314</td>
<td>Introduction to Modern Physics</td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

Select one group from the following: 3-4

- **Group A**
  - CS 152 Python for STEM
  - MATH 151 or STAT 158 Mathematical Algorithms in Matlab I
  - Introduction to R Programming

- **Group B**
  - CS 163 or 164 CS1—No Prior Programming Experience
  - CS1—Computational Thinking with Java

Career Development Seminar

Total Credits 30-31
### Junior

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOM 300</td>
<td>Problem-Based Learning Biomedical Engr Lab</td>
<td>4</td>
</tr>
<tr>
<td>BMS 300</td>
<td>Principles of Human Physiology</td>
<td>4</td>
</tr>
<tr>
<td>ECE 311</td>
<td>Linear System Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>ECE 331</td>
<td>Electronics Principles I</td>
<td>4</td>
</tr>
<tr>
<td>ECE 332</td>
<td>Electronics Principles II</td>
<td>4</td>
</tr>
<tr>
<td>ECE 341</td>
<td>Electromagnetic Fields and Devices I</td>
<td>3</td>
</tr>
<tr>
<td>ECE 342</td>
<td>Electromagnetic Fields and Devices II</td>
<td>3</td>
</tr>
<tr>
<td>BME Broad Elective (see list below)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>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>)</td>
<td>3B 3B</td>
<td></td>
</tr>
<tr>
<td>Career Development Seminar¹</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td><strong>31</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Senior

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOM 431/ECE 431</td>
<td>Biomedical Signal and Image Processing</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 113</td>
<td>General Chemistry II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 245</td>
<td>Fundamentals of Organic Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>ECE 404</td>
<td>Experiments in Optical Electronics</td>
<td>2</td>
</tr>
<tr>
<td>ECE 441</td>
<td>Optical Electronics</td>
<td>3</td>
</tr>
<tr>
<td>ECE 457</td>
<td>Fourier Optics</td>
<td>3</td>
</tr>
<tr>
<td>ECON 202</td>
<td>Principles of Microeconomics (GT-SS1)</td>
<td>3C 3C</td>
</tr>
<tr>
<td>MECH 262</td>
<td>Engineering Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>MECH 337</td>
<td>Thermodynamics</td>
<td>4</td>
</tr>
<tr>
<td>PH 353</td>
<td>Optics and Waves</td>
<td>4</td>
</tr>
<tr>
<td>Career Development Seminar¹</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td><strong>33</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Fifth Year

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOM 486A</td>
<td>Biomedical Design Practicum: Capstone Design I</td>
<td>4A,4B,4C</td>
</tr>
<tr>
<td>BIOM 486B</td>
<td>Biomedical Design Practicum: Capstone Design II</td>
<td>4A,4B,4C</td>
</tr>
<tr>
<td>PH 451</td>
<td>Introductory Quantum Mechanics I</td>
<td>3</td>
</tr>
<tr>
<td>Select one course from the following:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO 301B</td>
<td>Writing in the Disciplines: Sciences (GT-CO3)</td>
<td>2</td>
</tr>
<tr>
<td>JTC 300</td>
<td>Strategic Writing and Communication (GT-CO3)</td>
<td>2</td>
</tr>
<tr>
<td>ECE Lasers &amp; Optical Engineering Technical Electives (<a href="http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#arts-humanities">See list below</a>)</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>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>)</td>
<td>3B 3B</td>
<td></td>
</tr>
<tr>
<td>Diversity, Equity, and Inclusion (<a href="http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#diversity-equity-inclusion">http://catalog.colostate.edu/general-catalog/all-university-core-curriculum/aucc/#diversity-equity-inclusion</a>)</td>
<td>1C 1C</td>
<td></td>
</tr>
<tr>
<td>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>)</td>
<td>3D 3D</td>
<td></td>
</tr>
<tr>
<td>Career Development Seminar¹</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td><strong>31</strong></td>
<td></td>
</tr>
</tbody>
</table>

### ECE Lasers & Optical Engineering Technical Electives

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 471A</td>
<td>Semiconductor Physics</td>
<td>1</td>
</tr>
</tbody>
</table>

A maximum of 3 credits from the following may be used to satisfy var. this requirement:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 471B</td>
<td>Semiconductor Junctions</td>
<td>1</td>
</tr>
<tr>
<td>ECE 495A</td>
<td>Independent Study</td>
<td></td>
</tr>
<tr>
<td>ECE 495B</td>
<td>Independent Study: Open Option Project</td>
<td></td>
</tr>
</tbody>
</table>
### BME Broad Electives - Select 3 credits

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE 495C</td>
<td>Independent Study: Vertically Integrated Projects</td>
<td>3</td>
</tr>
<tr>
<td>ECE 503</td>
<td>Ultrafast Optics</td>
<td>3</td>
</tr>
<tr>
<td>ECE 504</td>
<td>Physical Optics</td>
<td>3</td>
</tr>
<tr>
<td>ECE 505</td>
<td>Nanostructures: Fundamentals and Applications</td>
<td>3</td>
</tr>
<tr>
<td>ECE 506</td>
<td>Optical Interferometry and Laser Metrology</td>
<td>3</td>
</tr>
<tr>
<td>ECE 507</td>
<td>Plasma Physics and Applications</td>
<td>3</td>
</tr>
<tr>
<td>ECE 517/BIM 517</td>
<td>Advanced Optical Imaging</td>
<td>3</td>
</tr>
<tr>
<td>ECE 518/BIM 518</td>
<td>Biophotonics</td>
<td>3</td>
</tr>
<tr>
<td>ECE 526/BIM 526</td>
<td>Biological Physics</td>
<td>3</td>
</tr>
<tr>
<td>ECE 527B/ BIOM 527B</td>
<td>Biosensing: Signal and Noise in Biosensors</td>
<td>1</td>
</tr>
<tr>
<td>ECE 527F/ BIOM 527F</td>
<td>Biosensing: Biophotonic Sensors Using Refractive Index</td>
<td>1</td>
</tr>
<tr>
<td>ECE 546</td>
<td>Laser Fundamentals and Devices</td>
<td>3</td>
</tr>
<tr>
<td>ECE 572</td>
<td>Semiconductor Transistors</td>
<td>1</td>
</tr>
<tr>
<td>ECE 573</td>
<td>Semiconductor Optoelectronics Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>ECE 574</td>
<td>Optical Properties in Solids</td>
<td>3</td>
</tr>
<tr>
<td>MATH 419</td>
<td>Introduction to Complex Variables</td>
<td>3</td>
</tr>
<tr>
<td>PH 315</td>
<td>Modern Physics Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>PH 425</td>
<td>Advanced Physics Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>PH 452</td>
<td>Introductory Quantum Mechanics II</td>
<td>3</td>
</tr>
<tr>
<td>PH 462</td>
<td>Statistical Physics</td>
<td>3</td>
</tr>
</tbody>
</table>

### Dual Degree Program: Biomedical Engineering combined with Electrical Engineering, Lasers and Optical Engineering Concentration

#### Course Titles

- BME 526/ECE 526 Biological Physics
- BIM 527A/ ECE 527A Biosensing: Cells as Circuits
- BIM 527B/ ECE 527B Biosensing: Signal and Noise in Biosensors
- BIM 527C/ ECE 527C Biosensing: Sensor Circuit Fundamentals
- BIM 527D/ ECE 527D Biosensing: Electrochemical Sensors
- BIM 527E/ ECE 527E Biosensing: Affinity Sensors
- BIM 527F/ ECE 527F Biosensing: Biophotonic Sensors Using Refractive Index
- BIM 531/MECH 531 Materials Engineering
- BIM 532/MECH 532 Materials Issues in Mechanical Design
- BIM 533/CIVE 533 Biomolecular Tools for Engineers
- BIM 537/ECE 537 Biomedical Signal Processing
- BIM 570/MECH 570 Bioengineering
- BIM 573/MECH 573 Structure and Function of Biomaterials
- BIM 574/MECH 574 Bio-Inspired Surfaces
- BIM 576/MECH 576 Quantitative Systems Physiology
- BIM 578/MECH 578 Musculoskeletal Biomedical Mechanics
- BIM 579/MECH 579 Cardiovascular Biomechanics
- BMS 301 Human Gross Anatomy
- BMS 302 Laboratory in Principles of Physiology
- BMS 305 Domestic Animal Gross Anatomy
- BMS 310 Anatomy for the Health Professions
- BMS 325 Cellular Neurobiology
- BMS 330 Microscopic Anatomy
- BMS 345 Functional Neuroanatomy
- BMS 405 Nerve and Muscle-Toxins, Trauma and Disease
- BMS 409 Human and Animal Reproductive Biology
- BMS 420 Cardiopulmonary Physiology
- BMS 430 Endocrinology
- BMS 450 Pharmacology
- BMS 460 Essentials of Pathophysiology
- BMS 500 Mammalian Physiology I
- BMS 501 Mammalian Physiology II
- BMS 503/NB 503 Developmental Neurobiology
- BMS 505/NB 505 Neuronal Circuits, Systems and Behavior
- BMS 545 Neuroanatomy
- BMS 575 Human Anatomy Dissection
- BSPM 302 Applied and General Entomology
- BSPM 361 Elements of Plant Pathology
- BSPM 576/MIP 576 Bioinformatics
- BZ 310 Cell Biology
- BZ 311 Developmental Biology
- BZ 348/MATH 348 Theory of Population and Evolutionary Ecology
- BZ 350 Molecular and General Genetics
- BZ 360 Bioinformatics and Genomics
- BZ 420 Evolutionary Medicine
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BZ 476/BZ 576</td>
<td>Genetics of Model Organisms</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 322</td>
<td>Basic Hydrology</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 330</td>
<td>Ecological Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 360</td>
<td>Mechanics of Solids</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 367</td>
<td>Structural Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 401</td>
<td>Hydraulic Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 413</td>
<td>Environmental River Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 423</td>
<td>Groundwater Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 438</td>
<td>Fundamentals of Environmental Engr</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 439</td>
<td>Applications of Environmental Engr Concepts</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 440</td>
<td>Nonpoint Source Pollution</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 442</td>
<td>Air Quality Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 504</td>
<td>Wind Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 520</td>
<td>Physical Hydrology</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 531</td>
<td>Groundwater Hydrology</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 538</td>
<td>Aqueous Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 539A</td>
<td>Principles of NMR and MRI: Basic NMR Principles</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 246</td>
<td>Fundamentals of Organic Chemistry Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 261</td>
<td>Fundamentals of Inorganic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 311</td>
<td>Introduction to Nanoscale Science</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 334</td>
<td>Quantitative Analysis Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 335</td>
<td>Introduction to Analytical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 338</td>
<td>Environmental Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 431</td>
<td>Instrumental Analysis</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 432</td>
<td>Clinical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 440</td>
<td>Advanced Organic Chemistry Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 461</td>
<td>Inorganic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 522</td>
<td>Methods of Chemical Biology</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 532</td>
<td>Advanced Chemical Analysis II</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 537</td>
<td>Electrochemical Methods</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 539A</td>
<td>Principles of NMR and MRI: Basic NMR Principles</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 539B</td>
<td>Principles of NMR and MRI: NMR Diffusion Measures-2D NMR and MRI</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 539C</td>
<td>Principles of NMR and MRI: Advanced NMR and MRI Techniques</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 541</td>
<td>Organic Molecular Structure Determination</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 543</td>
<td>Structure/Mechanisms in Organic Chemistry</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 545</td>
<td>Synthetic Organic Chemistry I</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 547</td>
<td>Physical Organic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 555</td>
<td>Chemistry of Sustainability</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 560</td>
<td>Foundations of Inorganic Synthesis</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 566</td>
<td>Bioorganic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 567</td>
<td>Crystallographic Computation</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 578A</td>
<td>Computational Chemistry: Electronic Structure</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 589</td>
<td>Chemical Crystallography</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 570</td>
<td>Chemical Bonding</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 575</td>
<td>Fundamentals of Chemical Thermodynamics</td>
<td>1</td>
</tr>
<tr>
<td>CHEM 576</td>
<td>Statistical Mechanics</td>
<td>2</td>
</tr>
<tr>
<td>CHEM 577</td>
<td>Surface Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 579</td>
<td>Chemical Kinetics</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 524/WR 524</td>
<td>Modeling Watershed Hydrology</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 525</td>
<td>Coupled Electromechanical Systems</td>
<td>3</td>
</tr>
<tr>
<td>ECE 500</td>
<td>3D Printing Lab for Engineers</td>
<td>1</td>
</tr>
<tr>
<td>ECE 502</td>
<td>Technology Entrepreneurship</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 510</td>
<td>Engineering Optimization: Method/Application</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 522</td>
<td>Intellectual Property and Invention Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 570</td>
<td>Coupled Electromechanical Systems</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 320</td>
<td>Environmental Health–Water Quality</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 332</td>
<td>Principles of Epidemiology</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 400</td>
<td>Radiation Safety</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 410</td>
<td>Environmental Health-Air and Waste Management</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 430</td>
<td>Human Disease and the Environment</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 446</td>
<td>Environmental Toxicology</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 448</td>
<td>Environmental Contaminants</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 450</td>
<td>Introduction to Radiation Biology</td>
<td>3</td>
</tr>
<tr>
<td>CS 152</td>
<td>Python for STEM</td>
<td>2</td>
</tr>
<tr>
<td>CS 163</td>
<td>CS1—No Prior Programming Experience</td>
<td>2</td>
</tr>
<tr>
<td>CS 164</td>
<td>CS1—Computational Thinking with Java</td>
<td>2</td>
</tr>
<tr>
<td>CS 165</td>
<td>CS2—Data Structures</td>
<td>4</td>
</tr>
<tr>
<td>CS 220</td>
<td>Discrete Structures and their Applications</td>
<td>4</td>
</tr>
<tr>
<td>CS 253</td>
<td>Software Development with C++</td>
<td>4</td>
</tr>
<tr>
<td>CS 270</td>
<td>Computer Organization</td>
<td>4</td>
</tr>
<tr>
<td>CS 314</td>
<td>Software Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CS 320</td>
<td>Algorithms—Theory and Practice</td>
<td>3</td>
</tr>
<tr>
<td>CS 356</td>
<td>Systems Security</td>
<td>3</td>
</tr>
<tr>
<td>CS 370</td>
<td>Operating Systems</td>
<td>3</td>
</tr>
<tr>
<td>CS 4**</td>
<td>Any 400-level CS course except CS 495</td>
<td>2</td>
</tr>
<tr>
<td>CS 5**</td>
<td>Any 500-level CS course</td>
<td>2</td>
</tr>
<tr>
<td>DSCI 320</td>
<td>Optimization Methods in Data Science</td>
<td>3</td>
</tr>
<tr>
<td>ECE 4**</td>
<td>Any 400-level ECE course not otherwise required for the degree; also excluding ECE 495</td>
<td>3</td>
</tr>
<tr>
<td>ECE 5**</td>
<td>Any ECE 500-level course</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 300</td>
<td>3D Printing Lab for Engineers</td>
<td>1</td>
</tr>
<tr>
<td>ENGR 422</td>
<td>Technology Entrepreneurship</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 510</td>
<td>Engineering Optimization: Method/Application</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 525</td>
<td>Intellectual Property and Invention Systems</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 570</td>
<td>Coupled Electromechanical Systems</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 320</td>
<td>Environmental Health–Water Quality</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 332</td>
<td>Principles of Epidemiology</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 400</td>
<td>Radiation Safety</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 410</td>
<td>Environmental Health-Air and Waste Management</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 430</td>
<td>Human Disease and the Environment</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 446</td>
<td>Environmental Toxicology</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 448</td>
<td>Environmental Contaminants</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 450</td>
<td>Introduction to Radiation Biology</td>
<td>3</td>
</tr>
</tbody>
</table>
Dual Degree Program: Biomedical Engineering combined with Electrical Engineering, Lasers and Optical Engineering Concentration

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERHS 502</td>
<td>Fundamentals of Toxicology</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 503</td>
<td>Toxicology Principles</td>
<td>1</td>
</tr>
<tr>
<td>ERHS 510/VS 510</td>
<td>Cancer Biology</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 530</td>
<td>Radiological Physics and Dosimetry I</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 540</td>
<td>Principles of Ergonomics</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 542</td>
<td>Biostatistical Methods for Qualitative Data</td>
<td>3</td>
</tr>
<tr>
<td>ERHS 547</td>
<td>Equipment and Instrumentation</td>
<td>3</td>
</tr>
<tr>
<td>ESS 353</td>
<td>Global Change Impacts, Adaptation, Mitigation</td>
<td>3</td>
</tr>
<tr>
<td>F 311</td>
<td>Forest Ecology</td>
<td>3</td>
</tr>
<tr>
<td>FIN 305</td>
<td>Fundamentals of Finance</td>
<td>3</td>
</tr>
<tr>
<td>FSHN 470</td>
<td>Integrative Nutrition and Metabolism</td>
<td>3</td>
</tr>
<tr>
<td>FTEC 447</td>
<td>Food Chemistry</td>
<td>2</td>
</tr>
<tr>
<td>GEOL 150</td>
<td>Physical Geology for Scientists and Engineers</td>
<td>4</td>
</tr>
<tr>
<td>GEOL 452</td>
<td>Hydrogeology</td>
<td>4</td>
</tr>
<tr>
<td>GEOL 454</td>
<td>Geomorphology</td>
<td>4</td>
</tr>
<tr>
<td>GES 441</td>
<td>Analysis of Sustainable Energy Solutions</td>
<td>3</td>
</tr>
<tr>
<td>GES 542</td>
<td>Biobased Fuels, Energy, and Chemicals</td>
<td>3</td>
</tr>
<tr>
<td>HES 207</td>
<td>Anatomical Kinesiology</td>
<td>3</td>
</tr>
<tr>
<td>HES 307</td>
<td>Biomechanical Principles of Human Movement</td>
<td>4</td>
</tr>
<tr>
<td>HES 319</td>
<td>Neuromuscular Aspects of Human Movement</td>
<td>4</td>
</tr>
<tr>
<td>HES 403</td>
<td>Physiology of Exercise</td>
<td>4</td>
</tr>
<tr>
<td>HES 420</td>
<td>Electrocardiography and Exercise Management</td>
<td>3</td>
</tr>
<tr>
<td>HES 476</td>
<td>Exercise and Chronic Disease</td>
<td>3</td>
</tr>
<tr>
<td>HORT 579</td>
<td>Mass Spectrometry Omics-Methods and Analysis</td>
<td>3</td>
</tr>
<tr>
<td>IDEA 310B</td>
<td>Design Thinking Toolbox: 3D Modeling</td>
<td>2</td>
</tr>
<tr>
<td>IDEA 310D</td>
<td>Design Thinking Toolbox: Digital Imaging</td>
<td>1</td>
</tr>
<tr>
<td>IDEA 310H/CS 310H</td>
<td>Design Thinking Toolbox: Mixed Reality Design</td>
<td>3</td>
</tr>
<tr>
<td>IDEA 455/MGT 455</td>
<td>Designing for Defense</td>
<td>3</td>
</tr>
<tr>
<td>LIFE 201B</td>
<td>Introductory Genetics: Molecular/Immunological/Developmental (GT-SC2)</td>
<td>3</td>
</tr>
<tr>
<td>LIFE 202B</td>
<td>Introductory Genetics Recitation: Molecular</td>
<td>1</td>
</tr>
<tr>
<td>LIFE 203</td>
<td>Introductory Genetics Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>LIFE 210</td>
<td>Introductory Eukaryotic Cell Biology</td>
<td>3</td>
</tr>
<tr>
<td>LIFE 211</td>
<td>Introductory Cell Biology Honors Recitation</td>
<td>1</td>
</tr>
<tr>
<td>LIFE 212</td>
<td>Introductory Cell Biology Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>LIFE 320</td>
<td>Ecology</td>
<td>3</td>
</tr>
<tr>
<td>MATH 151</td>
<td>Mathematical Algorithms in Matlab I</td>
<td>2</td>
</tr>
<tr>
<td>MATH 229</td>
<td>Matrices and Linear Equations</td>
<td>2</td>
</tr>
<tr>
<td>MATH 235</td>
<td>Introduction to Mathematical Reasoning</td>
<td>2</td>
</tr>
<tr>
<td>MATH 301</td>
<td>Introduction to Combinatorial Theory</td>
<td>3</td>
</tr>
<tr>
<td>MATH 317</td>
<td>Advanced Calculus of One Variable</td>
<td>3</td>
</tr>
<tr>
<td>MATH 331</td>
<td>Introduction to Mathematical Modeling</td>
<td>3</td>
</tr>
<tr>
<td>MATH 332</td>
<td>Partial Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>MATH 360</td>
<td>Mathematics of Information Security</td>
<td>3</td>
</tr>
<tr>
<td>MATH 366</td>
<td>Introduction to Abstract Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MATH 369</td>
<td>Linear Algebra I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 405</td>
<td>Introduction to Number Theory</td>
<td>3</td>
</tr>
<tr>
<td>MATH 417</td>
<td>Advanced Calculus I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 418</td>
<td>Advanced Calculus II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 419</td>
<td>Introduction to Complex Variables</td>
<td>3</td>
</tr>
<tr>
<td>MATH 430/ECE 430</td>
<td>Fourier and Wavelet Analysis with Apps</td>
<td>3</td>
</tr>
<tr>
<td>MATH 450</td>
<td>Introduction to Numerical Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 451</td>
<td>Introduction to Numerical Analysis II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 455</td>
<td>Mathematics in Biology and Medicine</td>
<td>3</td>
</tr>
<tr>
<td>MATH 460</td>
<td>Information and Coding Theory</td>
<td>3</td>
</tr>
<tr>
<td>MATH 465</td>
<td>Abstract Algebra I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 467</td>
<td>Abstract Algebra II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 469</td>
<td>Linear Algebra II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 470</td>
<td>Euclidean and Non-Euclidean Geometry</td>
<td>3</td>
</tr>
<tr>
<td>MATH 474</td>
<td>Introduction to Differential Geometry</td>
<td>3</td>
</tr>
<tr>
<td>MATH 525</td>
<td>Optimal Control</td>
<td>3</td>
</tr>
<tr>
<td>MATH 530</td>
<td>Mathematics for Scientists and Engineers</td>
<td>3</td>
</tr>
<tr>
<td>MATH 532</td>
<td>Mathematical Modeling of Large Data Sets</td>
<td>3</td>
</tr>
<tr>
<td>MATH 535</td>
<td>Foundations of Applied Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>MATH 546</td>
<td>Partial Differential Equations II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 550/ENGR 550</td>
<td>Numerical Methods in Science and Engineering</td>
<td>3</td>
</tr>
<tr>
<td>MATH 560</td>
<td>Linear Algebra</td>
<td>3</td>
</tr>
<tr>
<td>MECH 200</td>
<td>Introduction to Manufacturing Processes</td>
<td>3</td>
</tr>
<tr>
<td>MECH 307</td>
<td>Mechatronics and Measurement Systems</td>
<td>4</td>
</tr>
<tr>
<td>MECH 324</td>
<td>Dynamics of Machines</td>
<td>4</td>
</tr>
<tr>
<td>MECH 325</td>
<td>Machine Design</td>
<td>3</td>
</tr>
<tr>
<td>MECH 331</td>
<td>Introduction to Engineering Materials</td>
<td>4</td>
</tr>
<tr>
<td>MECH 4** - Any 400-level MECH Course except MECH 495</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MECH 5** - Any 500-level course</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MGT 305</td>
<td>Fundamentals of Management</td>
<td>3</td>
</tr>
<tr>
<td>MGT 340</td>
<td>Fundamentals of Entrepreneurship</td>
<td>3</td>
</tr>
<tr>
<td>MIP 300</td>
<td>General Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>MIP 302</td>
<td>General Microbiology Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>MIP 315</td>
<td>Pathology of Human and Animal Disease</td>
<td>3</td>
</tr>
<tr>
<td>MIP 334</td>
<td>Food Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>MIP 335</td>
<td>Food Microbiology Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>MIP 342</td>
<td>Immunology</td>
<td>4</td>
</tr>
<tr>
<td>MIP 343</td>
<td>Immunology Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>MIP 351</td>
<td>Medical Bacteriology</td>
<td>3</td>
</tr>
<tr>
<td>MIP 352</td>
<td>Medical Bacteriology Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>MIP 420</td>
<td>Medical and Molecular Virology</td>
<td>4</td>
</tr>
<tr>
<td>MIP 425</td>
<td>Virology and Cell Culture Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>MIP 432/ESS 432</td>
<td>Microbial Ecology</td>
<td>3</td>
</tr>
<tr>
<td>MIP 433/ESS 433</td>
<td>Microbial Ecology Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>MIP 443</td>
<td>Microbial Physiology</td>
<td>4</td>
</tr>
<tr>
<td>MIP 450</td>
<td>Microbial Genetics</td>
<td>3</td>
</tr>
<tr>
<td>MIP 530</td>
<td>Advanced Molecular Virology</td>
<td>4</td>
</tr>
<tr>
<td>MIP 543</td>
<td>RNA Biology</td>
<td>3</td>
</tr>
<tr>
<td>MIP 550</td>
<td>Microbial and Molecular Genetics Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>MIP 555</td>
<td>Principles and Mechanisms of Disease</td>
<td>3</td>
</tr>
<tr>
<td>MIP 578/BZ 578</td>
<td>Genetics of Natural Populations</td>
<td>4</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>MKT 305</td>
<td>Fundamentals of Marketing</td>
<td>3</td>
</tr>
<tr>
<td>MSE 501</td>
<td>Materials Technology Transfer</td>
<td>1</td>
</tr>
<tr>
<td>MSE 502A</td>
<td>Materials Science &amp; Engineering Methods:</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Materials Structure and Scattering</td>
<td></td>
</tr>
<tr>
<td>MSE 502B</td>
<td>Materials Science &amp; Engineering Methods:</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Computational Materials Methods</td>
<td></td>
</tr>
<tr>
<td>MSE 502C</td>
<td>Materials Science &amp; Engineering Methods:</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Materials Microscopy</td>
<td></td>
</tr>
<tr>
<td>MSE 502D</td>
<td>Materials Science &amp; Engineering Methods:</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Materials Spectroscopy</td>
<td></td>
</tr>
<tr>
<td>MSE 502E</td>
<td>Materials Science &amp; Engineering Methods:</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Bulk Properties and Performance</td>
<td></td>
</tr>
<tr>
<td>MSE 502F</td>
<td>Materials Science &amp; Engineering Methods:</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Experimental Methods for Materials Research</td>
<td></td>
</tr>
<tr>
<td>MSE 503</td>
<td>Mechanical Behavior of Materials</td>
<td>3</td>
</tr>
<tr>
<td>MSE 504</td>
<td>Thermodynamics of Materials</td>
<td>3</td>
</tr>
<tr>
<td>MSE 505</td>
<td>Kinetics of Materials</td>
<td>3</td>
</tr>
<tr>
<td>NR 319</td>
<td>Geospatial Applications in Natural Resources</td>
<td>4</td>
</tr>
<tr>
<td>NR 323/GR 323</td>
<td>Remote Sensing and Image Interpretation</td>
<td>3</td>
</tr>
<tr>
<td>NR 505</td>
<td>Concepts in GIS</td>
<td>4</td>
</tr>
<tr>
<td>PH 315</td>
<td>Modern Physics Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>PH 341</td>
<td>Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>PH 351</td>
<td>Electricity and Magnetism</td>
<td>4</td>
</tr>
<tr>
<td>PH 361</td>
<td>Physical Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>PH 425</td>
<td>Advanced Physics Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>PH 452</td>
<td>Introductory Quantum Mechanics II</td>
<td>3</td>
</tr>
<tr>
<td>PH 462</td>
<td>Statistical Physics</td>
<td>3</td>
</tr>
<tr>
<td>PH 517</td>
<td>Chaos, Fractals, and Nonlinear Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>PH 521</td>
<td>Introduction to Lasers</td>
<td>3</td>
</tr>
<tr>
<td>PH 522</td>
<td>Introductory Laser Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>PH 531</td>
<td>Introductory Condensed Matter Physics</td>
<td>3</td>
</tr>
<tr>
<td>PH 561</td>
<td>Elementary Particle Physics</td>
<td>3</td>
</tr>
<tr>
<td>PH 571</td>
<td>Mathematical Methods for Physics I</td>
<td>3</td>
</tr>
<tr>
<td>PH 572</td>
<td>Mathematical Methods for Physics II</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 410</td>
<td>Gödel's Incompleteness Theorems</td>
<td>3</td>
</tr>
<tr>
<td>PSY 253</td>
<td>Human Factors and Engineering Psychology</td>
<td>3</td>
</tr>
<tr>
<td>SOCR 330</td>
<td>Principles of Genetics</td>
<td>3</td>
</tr>
<tr>
<td>SOCR 400</td>
<td>Soils and Global Change–Science and Impacts</td>
<td>3</td>
</tr>
<tr>
<td>SOCR 455</td>
<td>Soil Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>SOCR 456</td>
<td>Soil Microbiology Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>SOCR 467</td>
<td>Soil and Environmental Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>SOCR 470</td>
<td>Soil Physics</td>
<td>3</td>
</tr>
<tr>
<td>SOCR 471</td>
<td>Soil Physics Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>SOCR 567</td>
<td>Environmental Soil Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>STAR 512</td>
<td>Design and Data Analysis for Researchers II</td>
<td>4</td>
</tr>
<tr>
<td>STAT 158</td>
<td>Introduction to R Programming</td>
<td>1</td>
</tr>
<tr>
<td>STAT 305</td>
<td>Sampling Techniques</td>
<td>3</td>
</tr>
<tr>
<td>STAT 331</td>
<td>Intermediate Applied Statistical Methods</td>
<td>3</td>
</tr>
<tr>
<td>STAT 341</td>
<td>Statistical Data Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>STAT 342</td>
<td>Statistical Data Analysis II</td>
<td>3</td>
</tr>
<tr>
<td>STAT 400</td>
<td>Statistical Computing</td>
<td>3</td>
</tr>
<tr>
<td>STAT 420</td>
<td>Probability and Mathematical Statistics I</td>
<td>3</td>
</tr>
<tr>
<td>STAT 421</td>
<td>Introduction to Stochastic Processes</td>
<td>3</td>
</tr>
<tr>
<td>STAT 430</td>
<td>Probability and Mathematical Statistics II</td>
<td>3</td>
</tr>
<tr>
<td>STAT 460</td>
<td>Applied Multivariate Analysis</td>
<td>3</td>
</tr>
<tr>
<td>SYSE 501</td>
<td>Foundations of Systems Engineering</td>
<td>3</td>
</tr>
<tr>
<td>SYSE 534</td>
<td>Human Systems Integration</td>
<td>3</td>
</tr>
</tbody>
</table>

1 Students are required to complete three Career Development Seminars: 1) Resume Writing; 2) Mock Interview or Behavior Based Interviewing; and 3) Using LinkedIn™. Completion of the required workshops may be spread over the student’s five-year program.

2 CS 152, MATH 151, STAT 158, and either CS 163 or CS 164 may be taken as BME Broad Elective ONLY when not taken to fulfill degree requirements. Credit not allowed for both CS 163 and CS 164.