SCHOOL OF BIOMEDICAL ENGINEERING
COLORADO STATE UNIVERSITY

B.S. Biomedical Engineering + B.S. Chemical & Biological Engineering

BME+CBE Curriculum and Career Guide Fall 2018

This Guide is designed to help students understand the academic requirements and selected career resources in the Colorado State University undergraduate dual-degree program in Biomedical Engineering and Chemical & Biological Engineering (BME+CBE). Students graduate with full BS degrees in *both* disciplines and benefit from classroom and experiential learning through lecture, team projects, laboratory, and design courses in a unique multidisciplinary environment. Ours is the first ABET-Accredited BME program in Colorado, and the only accredited BME degree in the country that has an obligatory tie to a partner degree.

During the first and second years, BME+CBE students are introduced to biomedical and chemical and biological engineering in addition to learning the fundamentals of physics and mathematics. The third year of study provides continued depth in BME and CBE, including a multidisciplinary, hands-on problem-based BME learning lab. The fourth year rounds out the CBE curriculum and adds two 'gateway' BME courses that transition key CBE concepts into BME applications. The fifth year culminates in a year-long capstone Senior Design course in which students work in multidisciplinary teams creating solutions to BME industry or research problems.

Students are required to satisfy the scholastic standards of the university, college, and engineering department. (Note that many CBE courses must be passed with a minimum grade of "C".) Full course descriptions and prerequisites can be found at http://www.catalog.colostate.edu. All-University Core Curriculum (AUCC – "General Education") courses can be found here. Students will also meet with their advisors each semester to review academic plans and university resources.

We also encourage students to get involved in experiential learning via research and internships. BME faculty are spread among four different colleges, providing students a broad range of research opportunities. BME's academic home is the Scott Bioengineering Building, a cutting-edge interdisciplinary research and academic facility that opened in 2013. The Student Success Center in the Scott Building helps students develop resumes and interviewing skills, and gain access to internships and co-ops. Study Abroad is also encouraged in our program, as biomedical engineering is a global field. Visit www.engr.colostate.edu/sbme for further information!

We are here to support your CSU experience and warmly welcome you to BME @ CSU!

Sincerely,

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Biomedical Engineering and Chemical Biological Engineering

Curriculum Checksheet - Effective Fall 2018 And After

Name: _____

Program Total Credits = 158

COURSE	NAME (PREREQS (";" DENOTES "AND"))	TERM	C
1st Year Fall			
BIOM 100	Overview of Biomedical Engineering	F	1
CHEM 111	General Chemistry I (MATH 118 or 141 or 155 or 160 or 161 or 229 or 261; CHEM 105 or an appropriate score in the chemistry preparation module)	F, S, SS	4
CHEM 112	General Chemistry Lab I (CHEM 111 or 117 or conc.)	F, S, SS	1
LIFE 102	Attributes of Living Systems	F, S, SS	4
MATH 160	Calculus for Physical Scientists I (MATH 124 and 126 (B or better))	F, S, SS	4
		Total	**14**
2nd Year Fall			
CBE 201	Material and Energy Balances (CBE 101 or 160 or conc. or MATH 151 or conc.; CHEM 111; LIFE 102 or conc.; PH 141 or conc.)	F	3
CBE 205	Fundamentals of Biological Engineering (CBE 101; CBE 160; LIFE 102)	F	3
CHEM 341	Modern Organic Chemistry I (CHEM 113)	F, S, SS	3
CHEM 114	General Chemistry Lab II (CHEM 112; CHEM 113 or conc.)	F, S, SS	1
CO 150	College Composition (CO 130 or placement by ACT or SAT or DSP Survey or Challenge Exam)	F, S, SS	3
MATH 261	Calculus for Physical Scientists III (MATH 161)	F, S,	4
		Total	**17**
3rd Year Fall			
BMS 300	Principles of Human Physiology (BZ 101 or 110 or LIFE 102; CHEM 103 or 107 or 111)	F, S, SS	4
CBE 310	Molecular Concepts and Applications (**CBE 210**; MATH 340)	F	3
CBE 330	Process Simulation (**CBE 210**; MATH 340)	F	3
CBE 331	Momentum Transfer and Mechanical Separations (**CBE 210**; MATH 340)	F	3
STAT 315	Statistics for Engineers and Scientists (MATH 155 or 160)	F, S, SS	3
		Total	**16**
4th Year Fall			
BIOM 421	Transport Phenomena in Biomedical Engineering (BMS 300; CBE 332 or MECH 344)	F	3
CBE 333	Chemical & Biological Engineering Lab I (CBE 332)	F	2
CBE 442	Separation Processes (**CBE 332**)	F	4
CBE 451	Chemical and Biological Engineering Design I (**CBE 320**; CBE 442 or conc.)	F	3
BME BE	BME Broad Elective	F, S, SS	3
		Total	**#**
5th Year Fall			
BIOM 486A	Biomedical Design Practicum: Capstone Design I (BIOM 300; (BIOM 421; CBE 320; CBE 442) or (BIOM 431; ECE 311; ECE 332; ECE 342) or (BIOM 441; MECH 301; MECH 307)	F	4
BME-TE	BME Technical Elective _____	F, S, SS	3
CBE-TE	CBE Technical Elective _____	F, S, SS	2
AUCC		F, S, SS	3
Advanced Writing	CHEM 301 or CO300 or CO301B or JTC 300 or LB 300 (CO150 or HONR193)	F, S, SS	3
		Total	**15**

COURSE	NAME (PREREQS (";" DENOTES "AND"))	TERM	C
1st Year Spring			
CBE 101	Introduction to Chemical and Biological Engineering (CBE 160 or conc.)	F, S	3
CBE 160	MATLAB for Chemical and Biological Engineers	F, S	1
CHEM 113	General Chemistry II (CHEM 107 or 111 or 117; MATH 124 or MATH 141, 155, 160, 161, 229, 261 or conc.)	F, S, SS	3
MATH 161	Calc for Physical Scientists II (MATH 124; MATH 159 or 160)	F, S, SS	4
PH 141	Physics for Scientists and Engineers I (MATH 126 or conc.; MATH 155 or 159 or 160 or conc.)	F, S, SS	5
		Total	**16**
2nd Year Spring			
CBE 210	Thermodynamic Process Analysis (**CBE 201**; MATH 261 or conc.)	S	3
CHEM 343	Modern Organic Chemistry II (CHEM 245 or 341 or 345)	F, S, SS	3
CHEM 344	Modern Organic Chemistry Laboratory (CHEM 114; CHEM343 or conc)	F, S, SS	2
MATH 340	Introduction to Ordinary Differential Equations (MATH 255 or 261)	F, S, SS	4
MECH 262	Engineering Mechanics (MATH 161; PH 141)	S	4
		Total	**16**
3rd Year Spring			
BC 351	Principles of Biochemistry (BZ 110 or 120 or LIFE 102; CHEM 245 or 341 or 345)	F, S, SS	4
BIOM 300	Problem-Based Learning BME Lab (BIOM 101 or BIOM 200 or (BIOM 100; CBE 205; MECH 262); MATH 340 or 345)	S	4
CBE 320	Chemical and Biological Reactor Design (**CBE 310 & 330**)	S	3
CBE 332	Heat and Mass Transfer Fundamentals (**CBE 330 & 331**)	S	3
CBE 393	Professional Development Seminar	S	1
AUCC	_____	F, S,	3
NOTE- 18 cr OK b/c 493 is a 1-cr 'light' class; no CBE labs; 3 cr AUCC		**Total**	**18**
4th Year Spring			
BIOM 422	Quantitative Systems and Synthetic Biology (BIOM 421 or CBE 320)	S	3
CBE 430	Process Control & Instrumentation (**CBE 320 & 442**)	S	3
CBE 443	Chemical and Biological Engineering Lab II (CBE 442)	S	2
PH 142	Physics for Scientists and Engineers II (MATH 161 or 255 or 271 or conc.; PH 141)	F, S	5
AUCC	_____	F, S, SS	3
		Total	**16**
5th Year Spring			
BIOM 486B	Biomedical Design Practicum: Capstone Design II (BIOM 486A; CBE 451 or ECE 312 or (MECH 325; MECH 344) or PH 353)	S	4
BME-TE	BME Technical Elective _____	F, S, SS	2
CBE-TE	CBE Technical Elective _____	F, S, SS	3
AUCC	_____	F, S, SS	3
AUCC	_____	F, S, SS	3
		Total	**15**

ıeck with your advisors regularly to ensure you are on track.

Additional All University Core Courses (AUCCs)

6 cr - 3B Arts and Humanities: _____

_____

3 cr - 3C Social/Behavioral Science:

3 cr - 3D Historical Perspective:

3 cr - 3E Global/Cultural Awareness:

Key:

"conc." = concurrent enrollment Term: F = Fall, S = Spring, SS = Summer Session

Grey indicates Biomedical Engineering courses

Light green indicates labs

Red indicates exceptionally time-consuming/difficult courses

Must have at least a "C" in BOLDED courses

Rev 5-5-2020

BME+CBE Technical Electives

Technical Electives (TEs) are designed to provide additional breadth and depth in the Biomedical and partner major degrees.

BME+CBE students must take 3-5 credits of BME TEs and 5-6 credits of CBE TEs chosen from the following lists.

Key:	
F - Fall	*** Available Every Other Year (Even)**
S - Spring	**** Available Every Other Year (Odd)**
SS - Summer	***Italics and ++ = DARS changes pending***
OAN - offered as needed	
See last page of this document for information on how to obtain course overrides	

NOTE: 1. Classes otherwise required for the degree are not allowed for TE credit.
2. Course availability changes frequently. Please check with individual departments regarding course availability.
3. Crosslisted courses (e.g. **BIOM/MECH 570**) in **BOLD** must be taken as *BIOM* courses to count for BME Technical Elective credit.

BME Technical Electives

• From the following BME Technical Elective list: BME+CBE Students who started SM18 take 3 credits; students who started FA18 and after take 5 credits of BME TEs

COURSE	NAME	TERM	CR
BC 401	Comprehensive Biochemistry I	F	3
BC 403	Comprehensive Biochemistry II	S	3
BC 404	Comprehensive Biochemistry Laboratory	F,S	2
BC 411	Physical Biochemistry	F	4
BC 463	Molecular Genetics	F	3
BC 465	Molecular Regulation of Cell Function	S	3
BC 565	Molecular Regulation of Cell Function	S	4
BIOM 350A	Prosthetics in Ecuador (DARS changes eff. FA20)	SS	1 or 2
BIOM/ECE 431	Biomedical Signal and Image Processing	*S*	*3*
BIOM 441	Biomechanics and Biomaterials	F	3
BIOM 476A/476B[1]	Biomedical Clinical Practicum I & II	F,S,SS	Δ 2-4
BIOM 495[1]	BME Independent Study	F,S,SS	Δ1-6
BIOM/CBE 504	Fundamentals of Biochemical Engineering	F	3
BIOM/ECE 518	Biophotonics	F**	3
BIOM/CBE 522	Bioseparation Processes	F	3
BIOM/MECH 525	Cell and Tissue Engineering	S*	3
BIOM/ECE 526	Biological Physics	F**	3
BIOM527 (A-F)	Biosensors	F,S,SS	1
BIOM/MECH 531	Materials Engineering	S	3
BIOM/CIVE 533	Biomolecular Tools for Engineers	F	3
BIOM/ECE 537	Biomedical Signal Processing	S*	3
BIOM/CBE 543	Membranes for Biotechnology and Biomedicine	F	3
BIOM/MECH 570	Bioengineering	S	3
BIOM/MECH 573	Structure and Function of Biomaterials	S	3
BIOM/MECH 574	Bio-Inspired Surfaces	S	3
BIOM/MECH 576	Quantitative Systems Physiology	S	4
BIOM/MECH 578	Musculoskeletal Biosolid Mechanics	F	3
BIOM/MECH 579	Cardiovascular Biomechanics	F**	3
BMS 301	Human Gross Anatomy	F,S,SS	5
BMS 302	Laboratory in Principles in Physiology	F,S	2
BMS 310	Anatomy for the Health Professions (online only)	F,S,SS	4
BMS 325	Cellular Neurobiology	F	3
BMS 345	Functional Neuroanatomy	F,S	4
BMS 405	Nerve and Muscle-Toxins, Trauma and Disease	S	3
BMS 409	Human and Animal Reproductive Biology	F	3
BMS 420	Cardiopulmonary Physiology	F	3
BMS 430	Endocrinology	F	3
BMS 450	Pharmacology	S	3
BMS 500	Mammalian Physiology I	F	4

BME Technical Electives

COURSE	NAME	TERM	CR
BMS 501	Mammalian Physiology II	S	4
BMS/NB 503	Developmental Neurobiology	S	3
BMS/NB 505	Neuronal Circuts, Systems and Behavior	S	3
BZ 310	Cell Biology (DARS changes eff. FA20)	F,S,SS	4
BZ 311	Developmental Biology	S,SS	4
BZ 350	Molecular and General Genetics	F,S,SS	4
BZ 476/BZ 576	Genetics of Model Organisms	F*/F	Δ 3-4
CBE 505	Biochemical Engineering Laboratory	F	1
CHEM 334	Quantitative Analysis Laboratory	F, S	1
CHEM 335	Introduction to Analytical Chemistry	F,S	3
CHEM 433	Clinical Chemistry	S**	3
CHEM 539 (A-C)	Principles of NMR and MRI	OAN	1
CM 501	Advanced Cell Biology	F	4
CM/NB 502	Techniques in Molecular & Cellular Biology	F	2
ECE/MECH 569	Micro-Electro-Mechanical Devices	S	3
ERHS 450	Introduction to Radiation Biology	S	3
ERHS 502	Fundamentals of Toxicology	F	3
ERHS 510/ VS 510	Cancer Biology	S	3
ERHS 540	Principles of Ergonomics	F	3
FSHN 470	Integrated Nutrition & Metabolism	F,S	3
HES 307	Biomechanical Principles of Human Movement	F,S,SS	4
HES 319	Neuromuscular Aspects of Human Movement	F,S	4
HES 403	Physiology of Exercise	F,S,SS	4
HES 476	Exercise and Chronic Disease	F,S,SS	3
MATH 455	Mathematics in Biology and Medicine	F**	3
MECH 543	Biofluid Mechanics	S**	3
MIP 300	General Microbiology	F,S,SS	3
MIP 302	General Microbiology Laboratory	F,S,SS	2
MIP 342	Immunology	F,S	4
MIP 343	Immunology Laboratory	S	2
MIP 351	Medical Bacteriology	S	3
MIP 352	Medical Bacteriology Lab	S	3
MIP 420	Medical and Molecular Virology	F	4
MIP 443	Microbial Physiology	S	4
MIP 450	Microbial Genetics	F	3
MIP/BSPM 576	Bioinformatics	F,S	3
NB 500/ BMS 502	Readings in Cellular Neruobiology	F	1

[1] A maximum total of 3 credits of BIOM 476 and/or BIOM 495 may be applied towards BME technical elective degree requirements.

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CBE Technical Electives for BME+CBE students

- **From the following CBE TE list, BME+CBE students who have taken CBE 160 must take 5 credits:**
- **From the following CBE TE list, BME+CBE students who have not taken CBE 160 must take 6 credits:**

COURSE	NAME	TERM	CR
ATS 555	Air Pollution	S**	3
ATS 560	Air Pollution Measurement	F	2
BC 401	Comprehensive Biochemistry I	F	3
BC 403	Comprehensive Biochemistry II	S	3
BC 404	Comprehensive Biochemistry Lab	F,S	2
BC 411	Physical Biochemistry	F	4
BC 441	3D Molecular Models for Biochemistry	F	1
BC 463	Molecular Genetics	F	3
BC 464	Molecular Genetics Recitation	F	1
BC 517	Metabolism	F,S	2
BC 521/CHEM 521	Principles of Chemical Biology	F	3
BIOM/ECE 517	Advanced Optical Imaging	F*	3
BIOM/MECH 525	Cell and Tissue Engineering	S*	3
BIOM/ECE 526	Biological Physics	F**	3
BIOM/MECH 531	Materials Engineering	S	3
BIOM/MECH 532	Material Issues in Mechanical Design	F	3
BIOM/CIVE 533	Biomolecular Tools for Engineers	F	3
BIOM/ECE 537	Biomedical Signal Processing	S*	3
BIOM/MECH 573	Structure and Function of Biomaterials	S	3
BIOM/MECH 574	Bio-Inspired Surfaces	S	3
BIOM/MECH 576	Quantitative Systems Physuiology	S	4
BIOM/MECH 579	Cardiovascular Biomechanics	F**	3
BMS 301	Human Gross Anatomy	F,S,SS	5
BMS 302	Laboratory in Principles in Physiology	F,S	2
BMS 305	Domestic Animal Gross Anatomy	S	4
BMS 325	Cellular Neurobiology	F	3
BMS 330	Microscopic Anatomy	S	4
BMS 345	Functional Neuroanatomy	F,S	4
BMS 409	Human and Animal Reproductive Biology	F	3
BMS 420	Cardiopulmonary Physiology	F	3
BMS 430	Endocrinology	F	3
BMS 450	Pharmacology	S	3
BMS 460	Essentials of Pathophysiology	S	3
BMS 500	Mammalian Physiology I	F	4
BMS 501	Mammalian Physiology II	S	4
BMS/NB 503	Developmental Neurobiology	S	3
BMS/NB 505	Neuronal Circuits, Systems and Behavior	S	3
BMS 545	Neuroanatomy	S	5
BMS 575	Human Anatomy Dissection	F	4
BSPM 302	Applied and General Entomology	F	2
BSPM 310 ++	*Understanding Pesticides*	*S**	*3*
BSPM 361	Elements of Plant Pathology	S	3
BSPM/MIP 576	Bioinformatics	F, S	3
BZ 310	Cell Biology	F,S,SS	4
BZ 311	Developmental Biology	S,SS	4
BZ 348/MATH 348	Theory of Population and Evolutionary Ecology	F	4

CBE Technical Electives for BME+CBE students

COURSE	NAME	TERM	CR
BZ 350	Molecular and General Genetics	F,S,SS	4
BZ 360	Bioinformatics and Genomics	S	3
CBE 406	Introduction to Transport Phenomena	F	3
CBE 439/CIVE 539	Environmental Engineering Chemical Concepts	F	3
CBE 501	Chemical Engineering Thermodynamics	F	3
CBE 502	Advanced Reactor Design	F	3
CBE 503	Transport Phenomena Fundamentals	S	3
CBE/BIOM 504	Fundamentals of Biochemical Engineering	F	3
CBE 505	Biochemical Engineering Laboratory	F**	1
CBE 514	Polymer Science and Engineering	S	3
CBE 521	Mathematical Modeling for Chemical Engineers	F	3
CBE 522/BIOM 522	Bioseparation Processes	F	3
CBE 524	Bioremediation	F**	1
CBE/CIVE 540	Advanced Biological Wastewater Processing	F	3
CBE 570	Biomolecular Engineering/Synthetic Biology	S	3
CHEM 261	Fundamentals of Inorganic Chemistry	S	3
CHEM 311	Introduction to Nanoscale Science	S*	3
CHEM 334	Quantitative Analysis Laboratory	F,S	1
CHEM 335	Introduction to Analytical Chemistry	F,S	3
CHEM 338	Environmental Chemistry	S**	3
CHEM 431	Instrumental Analysis	F	4
CHEM 433	Clinical Chemistry	S**	3
CHEM 440	Advanced Organic Chemistry Laboratory	F	2
CHEM 461	Inorganic Chemistry	S	3
CHEM 522	Methods of Chemical Biology	S	2
CHEM 532	Advanced Chemical Analysis II	OAN	3
CHEM 537	Electrochemical Methods	S**	3
CHEM 539 (A-C)	Principles of NMR and MRI	OAN	1
CHEM 541	Organic Molecular Structure Determination	S	2
CHEM 543	Structure/Mechanisms in Organic Chemistry	F	2
CHEM 545	Synthetic Organic Chemistry I	S	3
CHEM 547	Physical Organic Chemistry	OAN	3
CHEM 555	Chemistry of Sustainability	F	3
CHEM 569	Chemical Crystallography	S*	3
CHEM 570	Chemical Bonding	F*	3
CHEM 575	Fundamentals of Chemical Thermodynamics	F	1
CHEM 576	Statistical Mechanics	F	2
CHEM 577	Surface Chemistry	OAN	3
CHEM 579	Chemical Kinetics	F**	3
CIVE 322	Basic Hydrology	F,S	3
CIVE 330	Ecological Engineering	S	3
CIVE 360	Mechanics of Solids	F,S,SS	3
CIVE 401	Hydraulic Engineering	S	3
CIVE 413	Environmental River Mechanics	F	3
CIVE 423	Groundwater Engineering	S	3
CIVE 438	Environmental Engineering Concepts	F,S	3

CBE Technical Electives for BME+CBE students (Continued)			
Course	**Name**	**Term**	**Cr**
CIVE 440	Nonpoint Source Pollution	F	3
CIVE 442	Air Quality Engineering	S	3
CIVE 504	Wind Engineering	F	3
CIVE 520	Physical Hydrology	F	3
CIVE 531	Groundwater Hydrology	F	3
CIVE 538	Aqueous Chemistry	S	3
CIVE 560	Advanced Mechanics of Materials	F	3
CM 501	Advanced Cell Biology	F	4
CM 502/NB 502	Techniques in Molecular & Cellular Biology	F	2
CS 165	CS2 -- Data Structures	F,S	4
CS 220	Discrete Structures and their Applications	F,S	4
CS 270	Computer Organization	F,S	4
ECE 204	Introduction to Electrical Engineering	S	3
ECE/MATH 430 ++	*Fourier and Wavelet Analysis with Apps*	*S*	*3*
ENGR 510/VS 510	Engineering Optimization: Method/Application	F	3
ENGR 550/MATH 550	Numerical Methods in Science and Engineering	F,S	3
ERHS 320 ++	*Environmental Health - Water and Food Safety*	*F*	*3*
ERHS 332 ++	*Principles of Epidemiology*	*S*	*3*
ERHS 410 ++	*Environmental Health and Waste Management*	*S*	*3*
ERHS 446	Environmental Toxicology	F	3
ERHS 448	Environmental Contaminants: Exposure and Fate	F	3
ERHS 450	*Introduction to Radiation Biology*	*S*	*3*
ERHS 502	Fundamentals of Toxicology	F	3
ERHS 503 ++	*Toxicology Principles*	*S*	*1*
ERHS 510/ VS 510	Cancer Biology	S	3
ERHS 530 ++	*Radiological Physics and Dosimetry I*	*F*	*3*
ERHS 542 ++	*Biostatistical Methods for Qualitative Data*	*F*	*3*
ERHS 547	Equipment and Instrumentation	S	3
F 311	Forest Ecology	F,S	3
FTEC 447/ANEQ 447	Food Chemistry	S**	2
GEOL 150	Physical Geology for Scientists and Engineers	F	4
GEOL 452	Hydrogeology	F	4
GEOL 454	Geomorphology	S	4
GES 441	Analysis of Sustainable Energy Solutions	S	3
GES 542	Biobased Fuels, Energy, and Chemicals	S	3
HES 307	Biomechanical Principles of Human Movement	F,S,SS	4
HES 319	Neuromuscular Aspects of Human Movement	F,S	4
HES 403	Physiology of Exercise	F,S,SS	4
HES 420 ++	*Electrocardiography and Exercise Management*	*F,S*	*3*
HORT 579	Metabolomics Methods and Analysis	S	2
LIFE 201B	Introductory Genetics	F,S	3
LIFE 202B	Introductory Genetics Recitation	F,S	1
LIFE 203	Introductory Genetics Laboratory	S	2
LIFE 211	Introductory Cell Biology Honors Recitation	F,S	1
LIFE 212	Introductory Cell Biology Laboratory	F,S	2
LIFE 320	Ecology	F,S	3
MATH 301	Introduction to Combinatorial Theory	F	3
MATH 331	Introduction to Mathematical Modeling	F	3
MATH 332	Partial Differential Equations	S	3
MATH 360	Mathematics of Information Security	F	3

CBE Technical Electives for BME+CBE students (Continued)			
Course	**Name**	**Term**	**Cr**
MATH 366	Introduction to Abstract Algebra	F,S,SS	3
MATH 369	Linear Algebra I	F,S,SS	3
MATH 405	Introduction to Number Theory	S*	3
MATH 419	Introduction to Complex Variables	F	3
MATH 450	Introduction to Numerical Analysis I	F	3
MATH 451	Introduction to Numerical Analysis II	S	3
MATH 455	Mathematics in Biology and Medicine	F**	3
MATH 460	Information and Coding Theory	S	3
MATH 466	Abstract Algebra I	F	3
MATH 467	Abstract Algebra II	S**	3
MATH 469	Linear Algebra II	S	3
MATH 525	Optimal Control	S**	3
MATH 530	Mathematics for Scientists and Engineers	F	4
MATH 532	Mathematical Modeling of Large Data Sets	S	3
MATH 535	Foundations of Applied Mathematics	F	3
MATH 546	Partial Differential Equations II	S	3
MATH 560	Linear Algebra	F	3
MECH 303	Energy Engineering	F	3
MECH 307	Mechatronics and Measurement Systems	F,S	4
MECH 324	Dynamics of Machines	F	4
MECH 325	Machine Design	S	3
MECH 331	Introduction to Engineering Materials	F,S	4
MECH 407	Laser Applications in Mechanical Engineering	F	3
MECH 424	Advanced Dynamics	S	3
MECH 425	Mechanical Engineering Vibrations	F	4
MECH 431	Metals and Alloys	F	3
MECH 432	Engineering of Nanomaterials	F*	3
MECH 502	Advances/Additive Manufacturing Engineering	S	3
MECH 507	Laser Diagnostics for Thermosciences	S**	3
MECH 509	Design and Analysis in Engineering Research	S	3
MECH 513	Simulation Modeling and Experimentation	S	3
MECH 524	Principles of Dynamics	F	3
MECH 527	Hybrid Electeric Vehicle Powertrains	F	3
MECH 529	Advanced Mechanical Systems	F	3
MECH 530	Advanced Composite Materials	F	3
MECH 543	Biofluid Mechanics	S**	3
MECH 552	Applied Computational Fluid Dynamics	F**	3
MIP 300	General Microbiology	F,S,SS	3
MIP 302	General Microbiology Laboratory	F,S,SS	2
MIP 315	Pathology of Human and Animal Disease	F,S	3
MIP 334	Food Microbiology	F	3
MIP 335	Food Microbiology Laboratory	F**	2
MIP 342	Immunology	F,S	4
MIP 343	Immunology Laboratory	S	2
MIP 351	Medical Bacteriology	S	3
MIP 352	Medical Bacteriology Laboratory	S	3
MIP 420	Medical and Molecular Virology	F	4
MIP 425	Virology and Cell Culture Laboratory	F	2
MIP 432/ESS 432	Microbial Ecology	S*	3
MIP 433/ESS 433	Microbial Ecology Laboratory	S*	1

CBE Technical Electives for BME+CBE students (Continued)			
Course	**Name**	**Term**	**Cr**
MIP 443	Microbial Physiology	S	4
MIP 450	Microbial Genetics	F	3
MIP 530	Advanced Molecular Virology	S*	4
MIP 543	RNA Biology	F**	3
MIP 550	Microbial and Molecular Genetics Laboratory	S	4
MIP 555	Principles and Mechanisms of Disease	F	3
MIP 578/ BZ 578	Genetics of Natural Populations	F	4
MSE 501	Materials Technology Transfer	F	1
MSE 502 (A-F)	Materials Science & Engineering Methods	F,S	1
MSE 503	Mechanical Behaviors of Materials	S	3
MSE 504	Thermodynamics of Materials	F	3
MSE 505	Kinetics of Materials	S	3
NR 319	Geospatial Applications in Natural Resources	F,S	4
NR/GR 323	Remote Sensing and Image Interpretation	F	3
NR 505	Concepts in GIS	F	4
PH 314	Introduction to Modern Physics	S	4
PH 315	Modern Physics Laboratory	S	2
PH 341	Mechanics	F	4
PH 351	Electricity and Magnetism	S	4
PH 353	Optics and Waves	F	4
PH 361	Physical Thermodynamics	S	3
PH 451	Introductory Quantum Mechanics I	F	3
PH 452	Introductory Quantum Mechanics II	S	3
PH 517	Chaos, Fractals, and Non-linear Dynamics	S	3
PH 521	Introduction to Lasers	S	3
PH 522	Introductory Laser Laboratory	S	1
PH 531	Introductory Condensed Matter Physics	S	3
PH 561	Elementary Particle Physics	S	3
PH 571	Mathematical Methods for Physics I	F	3
PH 572	Mathematical Methods for Physics II	S	3
PHIL 410	Gödel's Incompleteness Theorems	OAN	3
SOCR 330	Priciples of Genetics	F,S,SS	3
SOCR 400	Soils and Global Change: Science and Impacts	F	3
SOCR 430	Applications of Plant Biotechnology	F*	3
SOCR 455	Soil Microbiology	F	3
SOCR 456	Soil Microbiology Laboratory	F	1
SOCR 467	Soil and Environmental Chemistry	S	3
SOCR 470	Soil Physics	F	3
SOCR 471	Soil Physics Laboratory	F	1

CBE Technical Electives for BME+CBE students (Continued)			
Course	**Name**	**Term**	
SOCR 567	Environmental Soil Chemistry	S	4
STAT 305	Sampling Techniques	F	3
STAT 341	Statistical Data Analysis I	F	3
STAT 342	Statistical Data Analysis II	S	3
STAT 400	Statistical Computing	F	3
STAT 420	Probability and Mathematical Statistics I	F	3
STAT 421	Introduction to Stachastic Processes	S	3
STAT 430	Probability and Mathematical Statistics II	S	3
STAT 460	Applied Multivariate Analysis	F,S,SS	3
STAT 512	Design and Data Analysis for Researchers II	S	4
STAT 548/CS 548	Bioinformatics Algorithms	F	4

A maximum of 3 credits may be selected from the following courses for CBE TEs:			
ENGR 422	Technology Entrepreneurship	S	3
ENGR 502	Engineering Project and Program Management	F,S	3
ENGR 525	Intellectual Property and Invention Systems	S	3
FIN 305	Fundamentals of Finance	F,S,SS	3
IDEA 310B	Design Thinking Toolbox: 3D Modeling	OAN	2
IDEA 310D	Design Thinking Toolbox: Digital Imaging	OAN	1
MGT 305	Fundamentals of Management	F,S,SS	3
MGT 340	Fundamentals of Entrpreneurship	F,S,SS	3
MKT 305	Fundamentals of Marketing	F,S,SS	3

NOTE: Other courses may be available as CBE Technical electives; contact the CBE department for further information.

To Request Overrides - Include your CSU ID and verification that you meet prerequisites. If you need an override for a non-engineering course, reach out to the prof and request override. For engineering courses, follow procedures as indicated below.

For 500-level BIOM courses, request permission from Sara.Mattern@colostate.edu (BME grad adviser) to request override.

For 500-level CBE courses, you should be able to register if you meet the pre-requisistes. If you need an override, request from prof; forward permission to Claire.Lavelle@colostate.edu.

For 500-level ECE courses, you should be able to register if you meet the pre-requisistes. If you need an override, request from prof; forward permission to Courtney.Johnsrud@colostate.edu

For CIVE courses, email your BME adviser with the reason you want the override (e.g. meet pre-reqs but are not in the major) and she will forward request to the department on your behalf.

For MECH courses, request approval via your BME adviser, who will forward to MECH on your behalf. Include your CSU ID#, whether you meet pre-reqs, and any extenuating circumstances/reason(s) for your request. If you do not have a 3.0+ GPA or meet prerequisites for 500-level courses, request permission from the prof and forward permission to your BME adviser with your request for override.

To request overrides for other courses (e.g. non-engr, 500-level or prereq override), email the course professor or the department teaching the course.

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SCHOOL OF BIOMEDICAL ENGINEERING
COLORADO STATE UNIVERSITY

Careers in Biomedical Engineering + Chemical&Biological Engineering (BME+CBE)

Biomedical engineering (BME) degree combined with chemical and biological engineering (BME+CBE) typically draws students interested in using biology and chemistry in engineering to solve problems in human and animal health. Our BME+CBE program has an emphasis on process engineering and also prepares students in diagnosing and/or treating diseases (such as cancer or tuberculosis), using medical devices that incorporate biology or chemistry (e.g., blood oxygenators or advanced wound-healing techniques), or working with advanced technologies such as artificial organs.

Learn more about biomedical engineers - http://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm in the Bureau of Labor Statistics Occupational Outlook Handbook or at the Biomedical Engineering Society: BMES.org.

Learn more about chemical engineers - http://www.bls.gov/ooh/architecture-and-engineering/chemical-engineers.htm in the Bureau of Labor Statistics Occupational Outlook Handbook.

Additional Resources: American Institute of Chemical Engineers (AIChE) http://www.aiche.org/; Materials Research Society http://www.asb-biomech.org/; American Peptide Society (www.americanpeptidesociety.org); American Protein Society www.proteinsociety.org; American Society for Gene and Cell Therapy (www.asgct.org).

Our alumni are working at places like Astra Zeneca, Beckman Coulter, Epic Healthcare, Genetech, Hyde Engineering, Juno Therapeutics, Kromatid, Los Alamos National Lab, Med Immune, Medsource, Medtronic, Penumbra, Raytheon, Symbios Technology, and Terumo BCT. Many are also in graduate schools (Stanford, MIT, CSU, New Zealand, Europe, USC, CU, and others).

Finding BME Internships/Jobs

Take advantage of CSU resources

- **Career Fairs** – fall and spring. Many biotech companies don't go to these, but some do. Check with companies for your partner majors, also.
- **Biotech Connect** – held in early March – networking event for biotech companies
- **Handshake** – internship/job posting database (https://career.colostate.edu/experience/handshake)
- **Engineering Success Center** – help with resumes, interviewing, job/internship search, co-ops

Attend events, look at job posting and company websites (sign up to have updated jobs sent to you)

- **Biomedical Engineering Society** – www.BMES.org
  - Active student chapter @CSU - https://www.engr.colostate.edu/organizations/bmes;
    - Email for further information/membership: csu.bmesociety@gmail.com
  - Job Postings - http://jobboard.bmes.org/search.cfm; especially good for academic positions.
- **Colorado Bioscience Association** (THE organization for biotech in CO): www.cobioscience.com
  - **Job postings** -- www.cobioscience.com/careers.php; www.aftercollege.com; www.glassdoor.com; www.biospace.com
  - **Local information and opportunities** -- find industry updates and a company directory in the back! http://www.cobioscience.com/sponsorship/marketing-magazine
- **General Biotech** - www.Biospace.com – wordsearch specific terms (i.e. medical devices, tissue engineering)
- **Pharmaceuticals** – www.ispe.org
- **Medical Device** - http://www.devicespace.com
- **Clinical Research** - http://www.biospace.com/clinicaspacejobs/home