BME+EE Technical Electives

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

BME-EE students must take 6 credits of BME TEs and 14 credits of ECE TEs chosen from the following lists.

Key:

F - Fall
S - Spring
SS - Summer

* Available Every Other Year (Even)
** Available Every Other Year (Odd)

Abbreviations: "may be taken conc." = "course may be taken concurrently"

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) are in italics and must be taken as *BIOM* courses to count for BME Technical Elective credit.

●BME+EE students must take 6 credits of BME TEs from the following list:

BME Technical Electives

COURSE	COURSE NAME & DESCRIPTION	Prerequsites	TERM	CR
BC 351	**Principles of Biochemistry:** Structure and function of biological molecules; biocatalysis; metabolism and energy transduction; gene expression.	(BZ 110 or BZ 120 or LIFE 102); (CHEM 245 or CHEM 341 or CHEM 345).	F, S, SS	4
BC 401	**Comprehensive Biochemistry I:** Macromolecular structure and dynamics; membranes; enzymes; bioenergetics.	(CHEM 245, CHEM 343, or CHEM 346, may be taken conc.); (MATH 155 or MATH 160).	F	3
BC 403	**Comprehensive Biochemistry II:** Metabolic pathways and their regulation; cellular biochemistry.	CHEM 245 or CHEM 341 or CHEM 345.	S	3
BC 404	**Comprehensive Biochemistry Laboratory:** Experimental approaches to studying macromolecules, metabolism, and gene expressions.	(BC 401, may be taken conc.); (CHEM 246 or CHEM 344 or CHEM 346); LIFE 212; LIFE 203	F,S	2
BC 411	**Physical Biochemistry:** Thermodynamics; reaction rates; quantum chemistry; spectroscopy; macromolecular folding and interactions; ligand binding; enzyme kinetics; membranes.	(BC 351 with a B or better or BC 401); (CHEM 113); (MATH 161 or MATH 255).	F	4
BC 463	**Molecular Genetics:** Molecular basis of gene structure, replication, repair, recombination, and expression.	(BC 401, or BC 351 with a C or better); (LIFE 201B or BZ 350 with a C or better).	F	3
BC 465	**Molecular Regulation & Cell Function:** Molecular regulation of cell organization, membrane formation, organelle biogenesis, cell communication, shape and motility, growth, aging, and death.	(LIFE 210); (BC 403, or BC 351 may be taken conc.)	S	3
BC 565	**Molecular Regulation of Cell Function:** Molecular regulation of cell organization, membrane formation, organelle biogenesis, cell communication, shape and motility, growth, aging, and death.	(LIFE 210); (BC 351 or BC 403, may be taken conc.)	S	4
BIOM 350A	**Study Abroad: Prosthetics in Ecuador:** Design and fabricate prosthetics for under-served populations in Ecuador. Will take place in Quito,Ecuador in partnership with Range of Motion Project (ROMP).	None	SS	1 or 2
BIOM 421	**Transport Phenomena in Biomedical Engineering:** Engineering models of active and passive mechanisms of momentum. Heat and mass transport in mammalian cells, tissues, and organ systems.	(BMS 300); (CBE 332 or MECH 344).	F	3
BIOM 422	**Kinetics of Biomolecular and Cellular Systems:** In-depth analysis of the systems approach to biology and biological engineering at the molecular and the cellular scales.	BIOM 421 or CBE 320	S	3
BIOM 441	**Biomechanics and Biomaterials:** Principles of biomechanics, biofluids, and biomaterials.	(BMS 300 may be taken conc.); CIVE 360; (MECH 324 may be taken conc.); (MECH 331, may be taken conc.);	F	3
BIOM 476 A-B	**Biomedical Clinical Practicum (formerly BIOM 486):** Biomedical lab work or exposure to the hospital/clinical environment.	BMS 300; BIOM 470	F,S,SS	2 or 4

BME Technical Electives (Continued)

COURSE	NAME	Prerequsites	TERM	CR
BIOM 495[1]	**BME Independent Study** (4 credits max allowed of BIOM 476 &/or 495)	None	F,S,SS	1-6
BIOM/ CBE 504	**Fundamentals of Biochemical Engineering:** Application of chemical engineering principles to enzyme kinetics, fermentation and cell culture, product purification, and bioprocess design.	(MIP 300); (MATH 255 or MATH 340); (BIOM 306/BTEC 306, or CBE 320, may be taken conc.)	S	3
BIOM/ ECE 518	**Biophotonics:** Engineering design principles of optical instrumentation for medical diagnostics. Light propagation and imaging in biological tissues.	ECE 342 or ECE 457 or MATH 340 or MATH 345.	F	3
BIOM/ CBE 522	**Bioseparation Processes:** Analysis of processes to recover and purify fermentation products.	CBE 331	F	3
BIOM/ MECH 525*	**Cell and Tissue Engineering:** Cell and tissue engineering concepts and techniques with emphasis on cellular response, cell adhesion kinetics, and tissue engineering design.	BC 351 or BMS 300 or BMS 500 or BZ 310 or NB 501.	S	3
BIOM/ ECE 526**	**Biological Physics:** Mathematical and physical modeling of biological systems. Mass transport in cellular environments. Electrical/mechanical properties of biomolecules.	(MATH 340 or MATH 345); (PH 122 or PH 142).	S	3
BIOM/MECH 527 (A-F)**	**Biosensing: Cells as Circuts** Treatment of biological cells as circuits and their electrical time-dependent function and frequency-dependent impedance.	(BIOM 101 or LIFE 102); CHEM 111; (MATH 340 or MATH 345); PH 142	F	1
BIOM/ MECH 531	**Materials Engineering:** Selection of structural engineering materials by properties, processing, and economics; materials for biomedical and biotechnology applications.	MECH 331 or MECH 431	S	3
BIOM/ CIVE 533	**Biomolecular Tools for Engineers:** Theoretical and practical aspects of biomolecular laboratory tools--PCR, cloning, sequencing, single-molecule optical techniques and live-cell imaging	BMS 300 or MIP 300.	F	3
BIOM/ ECE 537	**Biomedical Signal Processing:** Measuring, manipulating, and interpreting biomedical signals.	MATH 340 or ECE 311 or STAT 303.	S	3
BIOM/ CBE 543	**Membranes for Biotechnology and Biomedicine:** Polymeric membrane formation, modification, module design and applications to bioseparation and biomedical separations and tissue engineering.	CHEM 343; CBE 310.	F	3
BIOM/ MECH 570	**Bioengineering:** Physiological and medical systems analysis using engineering methods including mechanics, fluid dynamics, control electronics, and signal processing.	MECH 307; MECH 324.	F	3
BIOM/ MECH 573	**Structure and Function of Biomaterials**: Structure-function relationships of natural biomaterials; application to analysis of biomimetic materials and biomaterials used in medical devices.	MECH 331	S	3

●BME+EE students must take 6 credits of BME TEs from the following list:

BME Technical Electives				
BIOM/ MECH 574	**Bio-Inspired Surfaces:** Analysis of surface functionalities of various biological species; identification of design principles.	MECH 342; CHEM 111.	S	3
BIOM/ MECH 576	**Quantitative Systems Physiology:** Quantitative, model-oriented approach to cellular and systems physiology with design examples from biomedical engineering.	BMS 300; CHEM 113; MATH 340; PH 142.	S	4
BIOM/ MECH 578	**Musculoskeletal Biosolid Mechanics:** Application of engineering concepts to quantify the mechanical behavior of load-bearing biological tissues and orthopaedic implant performance.	CIVE 360	F	3
BIOM/MECH 579	**Cardiovascular Biomechanics:** Bio-mechanical principles and approaches in cardiovascular research	MATH 340; PH 142	F**	3
BMS 301	**Human Gross Anatomy:** Structure/function of the human body. Study of prosected human cadavers; clinical applications; living anatomy.	BZ 110 or LIFE 102.	F,S,SS	5
BMS 302	**Laboratory in Principles in Physiology:** Basic physiology lab exercises.	BMS 300 or BMS 360, may be taken conc.	F,S	2
BMS 310	**Anatomy for the Health Professions (Online):** Gross anatomy of the human body from a regional perspective, utilizing clinical applications as a basis for anatomical understanding.	LIFE 000 to 499	F, S, SS	4
BMS 325	**Cellular Neurobiology:** Cellular and molecular bases of nervous system function and behavior.	BMS 300 or BMS 360	F	3
BMS 345	**Functional Neuroanatomy:** Functional systems and circuits of the human brain and spinal cord.	BMS 300 or BMS 360.	S	4
BMS 405	**Nerve and Muscle-Toxins, Trauma and Disease:** Structure, composition, function of nerves and muscles, etiology of genetic and autoimmune neuromuscular diseases, alteration by toxins and nerve gas.	BMS 325 or BMS 345.	S	3
BMS 409	**Human and Animal Reproductive Biology:** Basis for male and female reproductive function in humans and animals.	BMS 300 or BMS 360	F	3
BMS 420	**Cardiopulmonary Physiology:** Normal and pathophysiology of cardiovascular and pulmonary systems.	BMS 300 or BMS 360	F	3
BMS 430	**Endocrinology:** Physiology of the glands of internal secretion.	BMS 300 or BMS 360	F	3
BMS 450	**Pharmacology:** Pharmacologic principles, absorption, distribution, metabolism, excretion, side effects, and actions of drugs.	(BMS 300 or BMS 360); (BC 351 or LIFE 210)	S	3
BMS 500	**Mammalian Physiology I:** Cell physiology of nerve, skeletal, cardiac and smooth muscle with an emphasis on how cellular functions integrate into systems behavior.	BMS 300 or BMS 360	F	4
BMS 501	**Mammalian Physiology II:** Respiratory, renal, digestive, endocrine, metabolic, and reproductive function.	BMS 300 or BMS 360	S	4

BME Technical Electives (Continued)				
BZ 310	**Developmental Biology:** Structure and function of cells emphasizing molecular mechanisms.	(BZ 110 or BZ 120 or LIFE 103); CHEM 113	F,S,SS	4
BZ 311	**Developmental Biology:** Developmental aspects of growth and differentiation stressed in higher plants and animals.	BZ 310	S,SS	4
BZ 350	**Molecular and General Genetics:** Mendelian, molecular, and population genetics emphasizing the molecular basis of genetics.	(BZ 110 or BZ 120 or LIFE 102); (STAT 201, STAT 301, STAT 307, or ERHS 307, may be taken conc.)	F,S,SS	4
BZ 476* BZ 576	**Genetics of Model Organisms:** Advanced topics in model genetic systems including molecular and developmental genetics.	BZ 350 or LIFE 201A or LIFE 201B or SOCR 330.	F	3
CBE 330	**Process Simulation:** Analysis of chemical and biological engineering problems by numerical simulation.	(CBE 210 with a C or better); MATH 340.	F	3
CBE 505	**Biochemical Engineering Laboratory:** Fermentation technology, bioprocess control, and protein purification	CBE 504, may be taken conc.	F**	1
CHEM 334	**Quantitative Analysis Laboratory:** Laboratory applications of principles presented in CHEM 335.	CHEM 114; (CHEM 335, may be taken conc.)	F, S	1
CHEM 335	**Intro to Analytical Chemistry:** Modern and classical applications and methods in analytical chemistry including statistical, kinetic, spectroscopic, and chromatographic analysis.	(CHEM 113 with a C or better); (CHEM 334, may be taken conc.)	F,S	3
CHEM 343	**Modern Organic Chemistry II:** Continued studies of reactions and mechanisms of organic molecules and biological chemistry	CHEM 245 or CHEM 341 or CHEM 345	F,S,SS	3
CHEM 344	**Modern Organic Chemistry Laboratory:** Laboratory applications of modern organic chemistry.	CHEM 114; (CHEM 343, may be taken conc.)	F,S,SS	2
CHEM 346	**Organic Chemistry II:** Continue studies of reactions and mechanisms of organic molecules. Laboratory applications of principles presented in lecture.	CHEM 345	F,S	4
CHEM 433**	**Clinical Chemistry:** Principles and methodology of clinical chemistry. Laboratory experience in methodology and method development.	CHEM 334; (BC 351 or BC 401).	S	3
CHEM 539A-C	**Principles of NMR and MRI:**	CHEM 474	S	1
CM 501	**Advanced Cell Biology:** Cell structure and organelle function.	BZ 310	F	4
CM/NB 502	**Techniques in Molecular & Cellular Biology:** Current methods in molecular and cellular neurobiology.	At least one course in each of the following - with lab: (BIO 100 to 481); (BZ 100 to 481); (LIFE 100 to 481); (BC 100 to 481); (PH 100 to 481	F	2
ECE/ MECH 569*	**Micro-Electro-Mechanical Devices:** Micro-electro-mechanical processes and applications in sensors, optics, and structures.	(ECE 331with a C or better) or MECH 344	S	3

●BME+EE students must take 6 credits of BME TEs from the following list:

BME Technical Electives				
ERHS 450	**Introduction to Radiation Biology:** Genetic and somatic effects of radiation on cells, tissues, and the whole organism; tumor therapy; carcinogenesis; risks vs. benefits of radiation.	LIFE 102	S	3
ERHS 502	**Fundamentals of Toxicology:** Fundamental principles of toxicology; dose-response, organ targets, toxic agents	(BMS 300 or BMS 36); (CHEM 245 or CHEM 341 or CHEM 345)	F	3
ERHS 510	**Cancer Biology:** Cancer biology, from epidemiology and classification, through the molecular basis of the phenotypes to detection and treatment.	BC 351 or (BC 403, may be taken conc.) or BZ 310 or CM 501.	S	3
ERHS 540	**Principles of Ergonomics:** Theory and practice of ergonomics	NA	F	3
FSHN 470	**Integrated Nutrition & Metabolism:** Influence of nutrition on roles and action of hormones and gene expression on metabolism.	BC 351; FSHN 350	F,S	3
HES 307	**Biomechanical Principles of Human Movement:** Study and elementary analysis of human motion based on anatomical and mechanical principles.	(HES 207 or BMS 301); (PH 121 or PH 141)	F,S,SS	4
HES 319	**Neuromuscular Aspects of Human Movement:** Neuromuscular anatomy and physiology of human movement. Applied/integrated topics: aging, muscle fatigue, training, force control, and neuromuscular disease	BMS 300; HES 207	F,S	4
HES 403	**Physiology of Exercise:** Effects of exercise on tissues, organs, and systems of the body.	BMS 300 or BMS 360	F,S,SS	4
HES 476	**Exercise and Chronic Disease:** Interaction of physical activity with pathophysiology and treatment of chronic diseases and conditions.	BC 351; FSHN 350; HES 403.	F,S,SS	3
MATH 455**	**Mathematics in Biology and Medicine:** Models in population biology, cell division, host-parasoid systems, bacterial growth and predator-prey systems.	BZ 348 or MATH 255 or MATH 340 or MATH 345 or MATH 348.	F	3
MECH 543**	**Biofluid Mechanics:** Fluid dynamic concepts for understanding fluid motion in living organs/organisms; advanced research applications.	(BIOM 421 or CBE 331 or CIVE 300 or MECH 342) or (BMS 300; PH 121) or (BMS 300; PH 141) or BMS420	S	3
MIP 300	**General Microbiology:** Structure, function, development, physiology, and molecular biology of microorganisms emphasizing bacteria.	(BZ 110, BZ 120,or LIFE 102); (CHEM 245, CHEM 341, or CHEM 345, may be taken conc.)	F,S,SS	3
MIP 302	**General Microbiology Laboratory:** Laboratory skills and techniques for isolating, characterizing, and identifying bacteria.	MIP 300, may be taken conc.	F,S	2

BME Technical Electives (Continued)				
MIP 342	**Immunology:** Principles of immunology: components of the immune system, interactions of humoral and cellular elements, and clinical applications of basic concepts	(BZ 350, LIFE 201B, LIFE 210, MIP250); (CHEM 245 or CHEM 341 or CHEM 345 may be taken conc.); MIP 300	F,S	4
MIP 343	**Immunology Laboratory:** Techniques used in research and clinical immunology, including diagnostic problem solving and data analysis.	MIP 302; (MIP 342, may be taken conc.)	S	2
MIP 351	**Medical Bacteriology:** Bacteria which cause human and veterinary diseases; host-parasite relationships, disease mechanisms, prevention, and therapy	MIP 342	S	3
MIP 352	**Medical Bacteriology Lab:** Laboratory skills and techniques necessary for identifying medically important bacteria.	MIP 302; (MIP 351, may be taken conc.)	S	3
MIP 420	**Medical and Molecular Virology:** Principles of animal virology: structure, classification, assay, diagnosis, control, replication, genetics, host-parasite relat'sps	(MIP 342); (BC 351, may be taken conc. or BC 401, may be taken conc.).	F	4
MIP 436*	**Industrial Microbiology**: Use of microorganisms for producing commercially valuable products.	LIFE 206 or MIP 302	F	4
MIP 443	**Microbial Physiology:** Structure, function of bacterial constituents; comparison with other organisms. Bacterial growth, energy production, biosynthesis	(MIP 300); (BC 351 or BC 401).	S	4
MIP 450	**Microbial Genetics:** Principles of genetics at molecular level; mutation, recombination, complementation, suppression, control of gene expression, and recombinant DNA.	MIP 300 and (BC 351, or BC 401, may be taken concurrently).	F	3
MIP/ BSPM 576	**Bioinformatics:** Technical computing across platforms using bioinformatics tools in molecular analysis.	MIP 275 or MIP 300 or MIP 450 or BC 451 or VC 663 or BZ 350 or CM 501 or CS 155 or ERHS 332 or STAT 307	F,S	3
NB 500	**Readings in Cellular Neruobiology:** Membrane properties of nerve and muscle; molecular mechanisms of synaptic function; neuro-muscular units.	(NB 501, may be taken conc) or BMS 500; at least one course in each of the following (BZ 100 to 481 or BIO 100 to 481 or LIFE 100 to 481); (BC 100 to 4810); (PH 100 to 481); (MATH 141 or MATH 155 or MATH 160 or MATH 161 or MATH 255 or MATH	F	1
NB 501	**Cellular and Molecular Neurophysiology:** Membrane properties of nerve and muscle; molecular mechanisms of synaptic function; neuromuscular units.	At least one course in each of the following (BZ 100 to 481 or BIO 100 to 481 or LIFE 100 to 481); (BC 100 to 4810); (PH 100 to 481); (MATH 141 or MATH 155 or MATH 160 or MATH	F	2
NB/BMS 503	**Developmental Neurobiology:** Molecular mechanisms involved in development of nervous system including differentiation, growth, pathfinding, and synaptogenesis	1 course of each of the following: (BZ 100 - 481); (BIO 100 - 481); (LIFE 100 to 481); (BC 100 to 481); (PH 100 to 481).	S	3
NB/BMS 505	**Neuronal Circuits, Systems and Behavior:** Anatomical and physiological organization of the nervous system.	BMS 325 or BMS 500 or NB 501.	S	3

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

●BME+EE students must take 14 credits of ECE TEs from the following courses:

ECE Technical Electives

Course	Course Title	Prerequisite	Terms	Credits
CS314	**Software Engineering:** Methods used to develop large-scale software projects in industry emphasizing design, implementation, and testing	CS 253 with a C or better	F, S	3
CS320	**Algorithms--Theory and Practice:** Analysis, design, implementation and applications of algorithms	(CS 165 with a C or better; (CS 220 with a C or better); (MATH 155 or MATH 160 with a C or better); (DSCI 329 ot MATH 229 orMATH 369 with a C or better)	F, S	3
CS356	**Systems Security:** Computer and system security, authentication, access control, malicious software, and software security.	(CS 253 with a C or better) or (CS 370 with a C or better)	F, S	3
CS370	**Operating Systems:** Introduction to operating systems including memory organization, I/O control, multitasking, process control, coordination, and resource management	(CS 165 with a C or better); (CS 270 or ECE 251 with a C or better)	F, S	3
CS410	**Introduction to Computer Graphics:** Graphics hardware and software; drawing simple objects; coordinate transformations in 2D and 3D; modeling and viewing complex 2D and 3D objects	(CS 253 with a C or better); (DCSI 369 or MATH 229 or MATH 369 with a C or better)	F	4
CS414	**Object-Oriented Design:** Object-oriented methods for large-scale software systems. Software design for reuse using patterns. WWW applications in languages, e.g., Java	CS 314 with a C or better.	F	4
CS420	**Introduction to Analysis of Algorithms:** Efficiency analysis, correctness proofs, design strategies, illustrations from domains such as graph theory, scheduling and optimization, geometry.	CS 314 with a C or better	F	4
CS430	**Database Systems:** Database analysis, design, administration, implementation, hierarchical, network relational models; data sublanguages; query facilities	CS 314 or CS 370 with a C or better	S	4
CS440	**Introduction to Artificial Intelligence:** Concepts, representations, and algorithms for applications of problem solving search, logical reasoning and machine learning	(CS 253 with a C or better); (ECE/STAT 303 or STAT 301 or STAT 307 or STAT 315 with a C or better)	F	4
CS445	**Introduction to Machine Learning:** Fundamental concepts and methods of computational data analysis, including pattern classification, prediction, visualization, and recent topics in deep learning	(CS 320 with a C or better); (ECE/STAT 303 or STAT 301 or STAT 307 or STAT 315 with a C or better)	S	4
CS453	**Introduction to Compiler Construction:** Functional components of a compiler: modules, interfaces, lexical and syntax analysis, error recovery, resource allocation, code generation	CS 314 with a C or better	S	4
CS455	**Introduction to Distributed Systems:** Distributed systems including model of distributed computations; concurrency; thread pools and scalable servers; distributed mutual exclusion; cloud computing; distributed graph algorithms; data representation formats; atomic transactions; large-scale storage systems; distributed shared memory; and overlays	CS 370 with a C or better	S	4
CS475	**Parallel Programming:** Parallel programming techniques for shared-memory and message-passing systems; process synchronization, communication; example languages	CS 320 or CS 370 with a C or better	F	4
CS510	**Image Computation:** Image generation theory and implementation, image manipulation/interpretation. Ray tracing, geometric and photometric manipulation, image matching	CS 410	S	4
CS520	**Analysis of Algorithms:** Asymptotic complexity, algorithm complexity, and problem complexity; the Master Method; parallel algorithms; algorithm design	CS 420	S	4
CS 530	**Fault-Tolerant Computing:** Achieving high reliability and fault tolerance. Fault modeling, testing, reliability evaluation, redundancy, tolerance. (NT-O)	CS 370	S	4
CS540	**Artificial Intelligence:** Knowledge representation and reasoning, search, planning, evolutionary computation, data mining, information retrieval, intelligent Web, agent systems	CS 440	S	4
CS545	**Machine Learning:** Computational methods that allow computers to learn; neural networks, decision trees, genetic algorithms, bagging and boosting	CS 440	F	4
CS553	**Algorithmic Language Compliers:** ompiler construction; lexical scanner generators, parser generators, dataflow analysis, optimization.	CS 453	F	4
CS 555	**Distributed Systems** Principles, paradigms, protocals and algorithms underlying modern distributed systems.	CS 455	F	4
CS556	**Computer Security:** Topics in computer security: concepts, threats, risks, access control models, trusted systems, cryptography, authentication	CS 356 or CS 455	F	4
CS557	**Advanced Networking:** Core internet protocols, including transport, routing, and security protocols. Protocol design principles. Network measurements and assessment	CS 457	S	4
CS575	**Parallel Processing:** Parallel and distributed computing models, algorithms, mapping and performance evaluations, parallel computing tools and applications	CS 475	F	4
ECE4XX	Any ECE course at the 400 level		F, S	Varies

●BME+EE students must take 14 credits of ECE TEs from the following courses:

ECE Technical Electives

ECE495 A-C	**Independent Study:** Development and implementation of a project in an electrical and computer engineering field of special interest under the supervision of a faculty member	NA	F, S, SS	1-6	MATH 470	**Euclidian and Non-Euclidian Geometry:** Topics from real Euclidean, affine metric and non-Euclidean geometries emphasizing methods and connections with other areas of mathematics	(MATH 229 or MATH 369); (MATH 261)	S	3
ECE5XX	Any ECE course at the 500 level		F,S	Varies	MATH 474	**Introduction to Differential Geometry:** Topics from real Euclidean, affine metric and non-Euclidean geometries emphasizing methods and connections with other areas of mathematics	MATH 261; MATH 369	F	3
MATH 417	**Advanced Calculus I:** Topology of Euclidean spaces, limits, derivatives and integrals on Euclidean spaces. Implicit functions and the implicit function theorem	MATH 369; MATH 317	F	3	MECH 564	**Fundamentals of Robot Mechanisms and Controls:** Kinematics of robots, controls for robots	MECH 417	S	3
MATH 418	**Advanced Calculus II:** Line and surface integrals, series, sequences and series of functions	MATH 417	S	3	PH315	**Modern Physics Lab:** Experiments in modern physics	PH 314 may be taken conc.	S	2
MATH 419	**Introduction to Complex Variables:** Analyticity, Cauchy integral theorem and formula, Taylor and Laurent series, residue calculus, conformal mapping and harmonic functions	MATH 261	F	3	PH425	**Advanced Physics Laboratory:** Advanced experiments in electricity and magnetism, statistical physics and quantum mechanics.	PH 315 and PH 451	S	2
MATH 450	**Intro to Numerical Analysis I:** Solutions of systems of linear and nonlinear equations, interpolation, approximation	(CS 156 or CS 163 or CS 164 or CS 253 or MATH 151); (MATH 255 or MATH 261)	F	3	PH451	**Introductory Quantum Mechanics I:** Schrodinger's theory of wave mechanics, potential wells, harmonic oscillators, wave packets, operators, angular momentum	(MATH 272 or MATH 340 or MATH 345); PH 314 with a C or better	F	3
MATH 451	**Intro to Numerical Analysis II:** Numerical computation of eigenvalues, numerical solution of ordinary and partial differential equations.	(CS 156 or CS 163 or CS 164 or CS 253 or MATH 151); (MATH 340 or MATH 345)	S	3	PH452	**Intro to Quantum Mechanics II:** Approximation techniques, perturbation theory, identical particles and spin, structure and spectra of atoms and molecules, hydrogen atom	PH 451	S	3
MATH 460	**Information and Coding Theory:** Entropy, mutual information, channel capacity, channel coding theorem, syndrome decoding, BCH codes, recent developments	(MATH 360 or MATH 366); MATH 369	S	3	PH462	**Statistical Physics:** Maxwell-Boltzmann, Fermi-Dirac, and Bose-Einstein distribution functions; kinetic theory; applications to solids, metals, semiconductors, and gases	MATH 340; PH 314; PH 361	F	3
MATH 466	**Abstract Algebra I:** Comprehensive introduction to groups, rings, and fields	MATH 235 or MATH 360 or MATH 366	F	3	STAT421	**Introduction to Stochastic Processes:** Modeling phenomena with stochastic processes and the simulation and analysis of stochastic process models.	(MATH 229 or MATH 369); STAT 420	S	3
MATH 469	**Linear Algebra II:** Abstract vector spaces, general theory of linear transformations, theory of determinants, canonical forms.	MATH 369	S	3					

[2] A maximum total of 3 credits of 495 Independent Study may be applied towards EE technical elective degree requirements.

To Request Overrides - Include your CSU ID and verification that you meet prerequisites; If you do not meet prerequisites, request permission from the prof and indicate why you think you would be successful in the course. If granted permisstion,
For 500-level BIOM courses, forward permission to 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, 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, 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. If you do not meet prerequisites for 500-level courses (cum 3.0+ gpa or coursework), request permission from the prof and forward permission to
To request overrides for other courses (e.g. 500-level or prereq override), email the course professor or the department teaching the course.