

## Potential Technical Elective Courses for CEAE Students

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Updated September 2018

Courses listed below may be used to fulfill technical electives for AREN and CVEN majors. You may take up to 6.0 credits of technical electives outside AREN/CVEN by consulting with your faculty advisor for final approval. Courses outside AREN/CVEN must still be on this list, or approved by department petition, even if approved by your faculty advisor.

**Any AREN/CVEN course 3000+ will count as a technical elective.**

**Any course outside AREN/CVEN must be specifically listed here, or it will not count as a technical elective. Other upper-division math, science, or engineering courses may be petitioned for approval – see your academic advisor for more information BEFORE enrolling in an unapproved course.**

Note: Pre-requisites may apply; you may want to consider using your free elective to fulfill a pre-requisite requirement for a course in which you are very interested. See the CU catalog: [www.colorado.edu/catalog](http://www.colorado.edu/catalog) for current course restrictions and pre-requisites.

Courses outside of CEAE may be restricted to students in that major, but exceptions may be made if space permits. For engineering courses, most departments have course request forms posted at <https://www.colorado.edu/engineering-advising/departmental-course-request-forms> for each semester. Otherwise, contact the department in charge of the course to request permission to enroll.

Do a course search to see which courses are being offered each semester.

### **College of Engineering and Applied Science:**

ASEN 3116 (3) Introduction to Biomedical Engineering  
ASEN 4090 (3) Global Positioning Systems Applications  
ASEN 4128 (3) Human Factors in Engineering and Design  
ASEN/ATOC 4215 (3) Descriptive Physical Oceanography  
ASEN 4216 (3) Neural Signals & Functional Brain Imaging  
ASEN 4218 (3) Large Space Structures Design  
ASEN 4238 (3) Computer-Aided Control Systems Design  
ASEN 4248 (3) Computer-Aided Control System Design 2  
ASEN 4426 (3) Neural Systems and Physiological Control

CHEN 3220 (3) Chemical Engineering Separations and Mass Transfer  
CHEN 3660 (3) Energy Fundamentals  
CHEN 4130 (3) Chemical Engineering Laboratory  
CHEN-4330 (3) Chemical Engineering Reaction Kinetics  
CHEN 4440 (3) Chemical Engineering Materials  
CHEN-4450 (3) Polymer Chemistry  
CHEN 4460 (3) Polymer Engineering  
CHEN-4520 (3) Chemical Process Synthesis  
CHEN 4521 (3) Physical Chemistry for Engineers  
CHEN-4530 (2) Chemical Engineering Design Project  
CHEN-4570 (4) Instrumentation and Process Control  
CHEN 4630 (1) Intellectual Property Law and Engineering  
CHEN 4650 (3) Particle Technology  
CHEN-4801 (3) Pharmaceutical Biotechnology  
CHEN 4803 (3) Metabolic Engineering  
CHEN 4805 (3) Biomaterials  
CHEN-4810 (3) Biological Engineering Laboratory  
CHEN 4820 (3) Biochemical Separations

CHEN-4830 (3) Chemical Engineering Biokinetics  
CHEN-4836 (3) Nanomaterials  
CHEN 5360 (3) Catalysis and Kinetics

CSCI 3002 (4) Fundamentals of Human Computer Interaction  
CSCI 3104 (4) Algorithms  
CSCI 3155 (4) Principles of Programming Languages  
CSCI 3202 (3) Introduction to Artificial Intelligence  
CSCI 3287 (3) Design and Analysis of Data Systems  
CSCI-3302 (3) Introduction to Robotics  
CSCI 3308 (3) Software Development Methods and Tools  
CSCI 3434 (3) Theory of Computation  
CSCI 3656 (3) Numerical Computation 1  
CSCI-3702 (3) Cognitive Science  
CSCI 3753 (4) Design and Analysis of Operating Systems  
CSCI 4113 (3) LINUX System Administration  
CSCI 4229 (3) Computer Graphics  
CSCI 4273 (3) Network Systems  
CSCI-4239 (3) Advanced Computer Graphics  
CSCI-4302 (3) Advanced Robotics  
CSCI 4308 (4) Software Engineering Project 1  
CSCI-4314 (3) Algorithms for Molecular Biology  
CSCI 4318 (4) Software Engineering Project 2  
CSCI 4348 (4) Startup Essentials: Entrepreneurial Projects in Computing  
CSCI 4446 (3) Chaotic Dynamics  
CSCI 4448 (3) Object Oriented Analysis and Design  
CSCI-4502 (3) Data Mining  
CSCI 4555 (3) Compiler Construction  
CSCI 4576 (4) High Performance Scientific Computing 1  
CSCI 4593 (3) Computer Organization  
CSCI 4753 (3) Computer Performance Modeling  
CSCI 4809 (3) Computer Animation

ECEN 3030 (3) Electrical/Electronic Circuits Non-Major  
ECEN 3170 (3) Electromagnetic Energy Conversion 1  
ECEN 3250 (5) Microelectronics  
ECEN 3300 (3) Linear Systems  
ECEN 3303 (3) Introduction to Robotics  
ECEN 3320 (3) Semiconductor Devices  
ECEN 3350 (3) Programming Digital Systems  
ECEN-3360 (3) Digital Design Laboratory  
ECEN 3400 (3) Electromagnetic Fields and Waves  
ECEN 3410 (3) Electromagnetic Waves and transmission  
ECEN 4106 (3) Photonics  
ECEN 4116 (3) Introduction to Optical Communications  
ECEN 4138 (3) Control Systems Analysis  
ECEN 4167 (3) Electromagnetic Energy Conversion 2  
ECEN 4224 (3) High Speed Digital Design  
ECEN 4242 (3) Communication Theory  
ECEN-4324 (3) Fundamentals of Microsystem Packaging  
ECEN-4341 (3) Bioelectromagnetics  
ECEN-4375 (3) Microstructures Laboratory  
ECEN-4517 (3) Power Electronics and Photovoltaic Power Systems Laboratory  
ECEN-4532 (3) Digital Signal Processing Laboratory  
ECEN-4553 (3) Compiler Construction  
ECEN 4555 (3) Principles of Energy Systems and Devices  
ECEN 4583 (3) Software System Development  
ECEN-4593 (3) Computer Organization

ECEN-4606 (3) Undergraduate Optics Laboratory  
ECEN-4616 (3) Optoelectronic System Design  
ECEN-4633 (3) Hybrid Embedded Systems  
ECEN-4634 (3) Microwave and RF Laboratory  
ECEN-4638 (3) Control Systems Laboratory  
ECEN-4643 (3) SW Engineering of Concurrent Systems  
ECEN-4652 (3) Communication Laboratory  
ECEN-4653 (3) Real-Time Digital Media  
ECEN-4743 (3) SW Engineering of Distributed Systems  
ECEN-4753 (3) Computer Performance Modeling  
ECEN 4797 (3) Introduction to Power Electronics  
ECEN-4811 (3) Neural Signals and Functional Brain Imaging  
ECEN-4827 (3) Analog IC Design  
ECEN 4831 (3) Brains, Minds, Computers  
ECEN 5107 (3) Electric Power Grid

EMEN 4100 (3) Engineering Economics  
EMEN 4110 (3) Supply Chain Management  
EMEN 4120 (3) Managing Business Processes

EVEN 4100 (3) Environmental Sampling and Analysis

GEEN 3400 (3) Invention and Innovation

MCEN 3022 (3) Heat Transfer  
MCEN 3025 (3) Component Design  
MCEN 3030 (3) Computational Methods  
MCEN 3032 (3) Thermodynamics 2  
MCEN-4026 (3) Manufacturing Processes and Systems  
MCEN-4037 (2) Measurements Lab  
MCEN-4043 (3) System Dynamics  
MCEN-4057 (3) Environmental Modeling  
MCEN-4115 (3-4) Mechatronics and Robotics I  
MCEN 4117 (3) Anatomy and Physiology for Engineers  
MCEN 4123 (3) Vibration Analysis  
MCEN 4124 (3) Mechanical Behavior of Materials  
MCEN-4127 (3) Biomedical Ultrasound  
MCEN 4131 (3) Air Pollution Control Engineering  
MCEN 4133 (3) Biomechanics  
MCEN 4135 (3) Wind Energy and Wind Turbine Design  
MCEN-4137 (3) Anatomy and Physiology 2  
MCEN 4141 (3) Indoor Air Pollution  
MCEN 4151 (3) Flow Visualization  
MCEN 4152 (3) Introduction to Combustion  
MCEN-4154 (3) Biocolloids and Biomembranes  
MCEN 4162 (3) Energy Conversion  
MCEN-4173 (3) Finite Element Analysis  
MCEN 4174 (3) Failure of Engineering Materials  
MCEN 4183 (3) Mechanics of Composite Materials  
MCEN 4194 (3) Electrochemical Energy Conversion and Storage  
MCEN 4228 (3) Sp Tp: Renewable and Sustainable Energy

### **College of Arts & Sciences:**

#### **Suggested technical courses outside engineering**

AIRR 3010 (3) Air Force Leadership Studies I

APPM 3010 (3) Chaos in Dynamical Systems  
APPM 3050 (3) Scientific Computing in Matlab  
APPM 3170 (3) Discrete Applied Mathematics  
APPM 3310 (3) Matrix Methods and Applications  
APPM-3350 (3) Advanced Engineering Calculus  
APPM 4120 (3) Introduction to Operations Research – **counts toward CEAE Engineering Science Track**  
APPM 4350 (3) Methods in Appl Math: Fourier Series/Boundary Value Prob – **counts toward CEAE Engineering Science Track**  
APPM 4360 (3) Methods in Appl Math: Complex Variables & Applications  
APPM 4380 (3) Modeling in Applied Mathematics  
APPM-4390 (3) Modeling in Mathematical Biology  
APPM 4440 (3) Undergraduate Applied Analysis 1  
APPM 4450 (3) Undergraduate Applied Analysis 2  
APPM 4560 (3) Markov Processes, Queues, and Monte Carlo Simulations  
APPM 4650 (3) Intermediate Numerical Analysis 1  
APPM 4660 (3) Intermediate Numerical Analysis 2  
APPM 4720 (3) Open Topics in Applied Mathematics

**For AREN students who do not take CVEN 3227, APPM 3570 Applied Probability or APPM 4570 Statistical Methods can be taken as a tech elective.**

ASTR/ATOC 3720 (3) Planets and Their Atmospheres  
ASTR-3730 (3) Astrophysics 1 - Stellar and Interstellar  
ASTR-3740 (3) Cosmology and Relativity  
ASTR-3750 (3) Planets, Moons, and Rings  
ASTR-3760 (3) Solar and Space Physics  
ASTR-3830 (3) Astrophysics 2 - Galactic and Extragalactic  
ASTR-4330 (3) Cosmochemistry

ATOC/GEOL 3070 (3) Introduction to Oceanography  
ATOC 3180 (3) Aviation Meteorology  
ATOC 3300 (3) Analysis of Climate and Weather Observations  
ATOC 3500 (3) Air Chemistry and Pollution  
ATOC 3600 (3) Principles of Climate  
ATOC/ASTR 3720 (3) Planets and Their Atmospheres  
ATOC-4200 (3) Biogeochemical Oceanography  
ATOC/ASEN 4215 (3) Descriptive Physical Oceanography  
ATOC-4700 (3) Weather Analysis and Forecasting  
ATOC 4720 (3) Intro to Atmospheric Dynamics  
ATOC 4750 (3) Desert Meteorology and Climate

CHEM 3311 (4) Organic Chemistry 1  
CHEM 3321 (1) Laboratory in Organic Chemistry 1  
CHEM 3331 (4) Organic Chemistry 2  
CHEM 3341 (1) Lab in Organic Chemistry 2  
CHEM 4011 (3) Modern Inorganic Chemistry  
CHEM 4021 (3) Inorganic Laboratory  
CHEM-4131 (3) Chemistry of Global Health  
CHEM-4141 (3) Environmental Water and Soil Chemistry  
CHEM 4171 (3) Instrumental Analysis  
CHEM 4181 (4) Instrumental Analysis Lecture and Laboratory 2  
CHEM-4251 (3) Materials Chemistry and Properties  
CHEM-4261 (3) Organic Materials: Structures and Functions  
CHEM-4271 (3) Chemistry of Solar Energy  
CHEM 4531 (3) Physical Chemistry 2  
CHEM 4581 (1) Physical Chemistry Lab 1  
CHEM 4591 (2) Physical Chemistry Lab 2  
CHEM 4611 (3) Survey of Biochemistry  
CHEM 4621 (3) Genome Databases: Mining and Management

CHEM 4711 (3) Foundations of Biochemistry  
CHEM 4751 (3) Current Topics in Biochemical Research  
CHEM 4761 (4) Biochemistry Laboratory  
CHEM 4791 (3) Bioorganic Chemistry in Biotechnology

EBIO 3040 (4) Conservation Biology  
EBIO 3080 (4) Evolutionary Biology  
EBIO 3110 (3) Population and Community Ecology  
EBIO 3170 (3) Mountain Ecology and Conservation  
EBIO 3180 (3) Global Ecology  
EBIO 3190 (3) Tropical Marine Ecology  
EBIO 3240 (4) Animal Behavior  
EBIO 3270 (3) Ecosystem Ecology  
EBIO-3400 (3) Microbiology  
EBIO 3630 (4) Parasitology  
EBIO 3850 (4) Animal Diversity: Invertebrates  
EBIO 4030 (3) Limnology  
EBIO 4060 (3) Landscape Ecology  
EBIO-4080 (4) Freshwater Phycology  
EBIO 4090 (2) Coral Reef Ecology  
EBIO 4100 (3) Advanced Ecology  
EBIO 4120 (2-4) Advanced Ecology  
EBIO 4140 (3) Plant Ecology  
EBIO 4150 (1-2) Techniques in Ecology  
EBIO 4160 (3) Introduction to Biogeochemistry  
EBIO 4175 (3) Scientific Basis for Ecosystem Management Public Lands  
EBIO 4290 (3) Phylogenetics and Comparative Biology  
EBIO 4410 (4) Biometry  
EBIO-4440 (4) Animal Developmental Diversity  
EBIO 4500 (4) Plant Biodiversity and Evolution  
EBIO 4510 (4) Plant Anatomy and Development  
EBIO-4520 (4) Plant Systematics  
EBIO-4530 (4) Functional Plant Biology  
EBIO-4550 (4) Plant Eco-Evo-Devo  
EBIO 4640 (2-4) Plant Field Studies  
EBIO 4660 (4) Insect Biology  
EBIO 4740 (3) Biology of Amphibians and Reptiles  
EBIO 4750 (4) Ornithology  
EBIO 4760 (4) Mammalogy

ENVS 3001 (3) Sustainable Solutions Consulting  
ENVS/EBIO 3040(4) Conservation Biology  
ENVS/PHYS 3070 (3) Energy and the Environment  
ENVS/CVEN 3434 (3) Introduction to Applied Ecology  
ENVS/GEOL 3520 (3) Energy and Climate Change: An Interdisciplinary Approach  
ENVS/ATOC 3600/ GEOG 3601 (3) Principles of Climate  
ENVS 4050 (3) Field Methods in Environmental Sciences  
ENVS/GEOL/EBIO 4160 (3) Intro to Biogeochemistry  
ENVS/GEOG 4201 (3) Biometeorology  
ENVS-4795 (3) Field Methods in Zoology and Botany

GEOG 3053 (4) Cartography: Visualization and Information Design  
GEOG 3251 (3) Mountain Geography  
GEOG 3301 (3) Analysis of Climate and Weather Observation  
GEOG 3351 (3) Biogeography  
GEOG 3412 (3) Conservation Practice and Resource Management  
GEOG 3511 (4) Introduction to Hydrology  
GEOG 3601 (3) Principles of Climate

GEOG 4023 (4) Introduction to Quantitative Methods in Human Geography  
GEOG 4043 (4) Cartography 2: Interactive & Multimedia Mapping  
GEOG 4093 (4) Remote Sensing of the Environment  
GEOG 4103 (4) Introduction to Geographic Information Science  
GEOG/ENVS 4201 (3) Biometeorology  
GEOG 4203 (4) Geographic Information Science: Modeling Applc  
GEOG 4241 (4) Principles of Geomorphology  
GEOG 4251 (4) Fluvial Geomorphology  
GEOG 4303 (4) GIS Programming for Spatial Analysis  
GEOG 4311 (3) Watershed Biogeochemistry  
GEOG 4321 (3-4) Snow Hydrology  
GEOG 4331 (3-4) Mountain Climatology  
GEOG 4371 (3) Forest Geography: Principles and Dynamics  
GEOG 4401 (3) Soils Geography  
GEOG 4501 (3) Water Resources & Water Management of Western US

GEOL 3010 (3) Introduction to Mineralogy  
GEOL 3020 (3) Petrology  
GEOL 3030 (3) Introduction to Hydrogeology  
GEOL 3040 (3) Global Change: The Recent Geological Record  
GEOL 3050 (2) GIS for Geologists  
GEOL/ATOC 3070 (3) Introduction to Oceanography  
GEOL 3120 (4) Structural Geology  
GEOL 3300 (3) Extraterrestrial Life  
GEOL 3320 (3) Introduction to Geochemistry  
GEOL 3410 (3) Paleobiology  
GEOL 3430 (4) Sedimentology and Stratigraphy  
GEOL 3520 (3) Energy and Climate Change: An Interdisciplinary Approach  
GEOL 3540 (3) Introduction to Petroleum Geology  
GEOL 3720 (3) Evolution of Life: The Geological Record  
GEOL 3950 (3) Natural Catastrophes & Geologic Hazards  
GEOL 4060 (4) Oceanography  
GEOL 4093 (4) Remote Sensing of the Environment  
GEOL 4130 (3) Principals of Geophysics  
GEOL 4160 (3) Introduction to Biogeochemistry  
GEOL 4241 (4) Principles of Geomorphology  
GEOL 4270 (3) Marine Chemistry and Geochemistry  
GEOL 4474 (4) Vertebrate Paleontology  
GEOL 4550 (3) Petroleum Reservoir Characterization & Modeling  
GEOL 4670 (3) Isotope Geology  
GEOL 4711 (2) Igneous and Metamorphic Field Geology  
GEOL 4712 (2) Structural Field Geology  
GEOL 4714 (2) Field Geophysics  
GEOL 4715 (2) Field Techniques in Hydrogeology  
GEOL 4716 (2) Environmental Field Geochemistry  
GEOL 4717 (2) Field Seminar in Geology and Tectonics

IPHY 3060 (4) Cell Physiology  
IPHY 3410 (3) Introduction to Human Anatomy  
IPHY 3415 (2) Human Anatomy Laboratory  
IPHY 3430 (3) Human Physiology  
IPHY 3435 (2) Physiology Laboratory  
IPHY 3450 (3) Comparative Animal Physiology  
IPHY 3460 (5) Comparative Vertebrate Anatomy  
IPHY 3470 (3) Human Physiology 1  
IPHY 3480 (3) Human Physiology 2  
IPHY 3500 (2) Applied Clinical Research  
IPHY 3660 (3) Dynamics of Motor Learning

IPHY 3800 (3) Forensic Biology  
IPHY 3810 (1) Forensic Biology Laboratory  
IPHY 4200 (3) Physiological Genetics and Genomics  
IPHY 4440 (3) Endocrinology  
IPHY 4470 (3) Biology of Human Reproduction  
IPHY 4480 (3) Comparative Reproduction  
IPHY 4740 (3) Theory of Motor Skills Learning

MATH 3110 (3) Introduction to Theory of Numbers  
MATH 3140 (3) Abstract Algebra 1  
MATH 3170 (3) Combinatorics 1  
MATH 3210 (3) Euclidean and Non-Euclidean Geometries  
MATH 4000 (3) Foundations of Mathematics  
MATH 4120 (3) Introduction to Operations Research  
MATH 4140 (3) Abstract Algebra 2  
MATH 4230 (3) Differential Geometry of Curves and Surfaces  
MATH 4330 (3) Fourier Analysis  
MATH 4440 (3) Mathematics of Coding and Cryptography  
MATH 4450 (3) Introduction to Complex Variables  
MATH 4470 (3) Partial Differential Equations  
MATH 4510 (3) Introduction to Probability Theory  
MATH 4520 (3) Introduction to Mathematical Statistics  
MATH 4540 (3) Introduction to Time Series  
MATH 4650 (3) Intermediate Numerical Analysis 1  
MATH 4660 (3) Intermediate Numerical Analysis 2  
MATH 4730 (3) Set Theory

NAVR 4010 (3) Leadership and Management I

PHYS/ENVS 3070 (3) Energy and the Environment  
PHYS 3210 (3) Classical Mechanics and Mathematical Methods 2  
PHYS 3220 (3) Quantum Mechanics  
PHYS 3310 (3) Principles of Electricity and Magnetism 1  
PHYS 3320 (3) Principles of Electricity and Magnetism 2  
PHYS 3330 (2) Electronics for the Physical Sciences  
PHYS 4130 (3) Biological Electron Microscopy: Principles and Recent Advances  
PHYS 4150 (3) Plasma Physics  
PHYS 4410 (3) Quantum Mechanics 2  
PHYS 4420 (3) Nuclear and Particle Physics  
PHYS 4510 (3) Optics

PSYC 4165 (4) Psychology of Perception

STAT 4520/5520 Introduction to Mathematical Statistics  
STAT 4540 (3) Introduction to Time Series  
STAT 4610 (3) Statistical Learning

THTR 3055 (3) Stage Lighting Design 1 – *approved for AREN Lighting & Electrical Systems concentration students only*

### **Leeds School of Business:**

#### **Business Minor courses approved as technical electives**

BUSM 3001 (3) Managing Innovation in Organizations  
BUSM 3002 (3) Business and Financial Analytics  
BUSM 3010 (1.5) Managing Innovation I  
BUSM 3011 (1.5) Managing Innovation II  
BUSM 3020 (1.5) Business and Financial Analytics I  
BUSM 3021 (1.5) Business and Financial Analytics II

**Program in Environmental Design:**

ENVD 3009 (6) Urban Site Analysis & Design in Rome (global seminar) – ***approved for 3 credits of technical electives***

ENVD 3152 (3) Introduction to Computer Graphics Applications: Geographic Info Systems (3)