**Technical Electives** Civil Engineering students are required to complete a **minimum of 15 semester credit hours of technical elective credit** hours from the following list of approved courses. Students are required to **complete at least one course from each of the three areas of concentration listed below**, with the remaining course work coming from any combination of areas.

**Area 1: Infrastructure (Structures, Soils and Construction)**

**Area 2: Transportation and Geodetic Engineering**

**Area 3: Water Resources and Environmental Engineering**

**Up to 3 total hours of Additional Technical Electives**, such as independent study, undergraduate research, internship in CE, CE seminar, etc., can be used towards the required technical electives hours.

1. Infrastructure (Structures, Soils and Construction)

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| **Course #** | **Course Title** | **Cr Hrs.** | **Offered** | **Prerequisites** |
| CIVILEN 4310 | Structural Analysis | 3 | AU | CIVILEN 3310 |
| CIVILEN 4320\* | Structural Steel Design | 3 | AU/SP | CIVILEN 3310 |
| CIVILEN 4340 | Behavior of Structural Elements | 3 | SP | CIVILEN 3310 |
| CIVILEN 4350\* | Reinforced Concrete Design | 3 | AU/SP | CIVILEN 3310 |
| CIVILEN 4552 | Design and Construction of Flexible Pavements | 3 | SP | CIVILEN 3510; and MATH 2177 or 2415 |
| CIVILEN 5162 | Introduction to Laminated Composite Materials (cross listed in MECHENG) | 3 | AU | MECHENG 2020 or 2040; or permission of instructor |
| CIVILEN 5168 | Introduction to Finite Element Method | 3 | SP | CIVILEN 2060, MATH 2568 or MECHENG 2850 |
| CIVILEN 5310 | Matrix Structural Analysis | 3 | SP | CIVILEN 4310 |
| CIVILEN 5320 | Intermediate Structural Steel Design | 3 | SP (even) | CIVILEN 4310; and CIVILEN 4320  *Course not currently in rotation* |
| CIVILEN 5350 | Intermediate Reinforced Concrete Design | 3 | AU (odd) | CIVILEN 4350 |
| CIVILEN 5360 | Bridge Engineering | 3 | SP (odd) | CIVILEN 4310; and CIVILEN 4320  *Course not currently in rotation* |
| CIVILEN 5370 | Prestressed Concrete Design | 3 | AU | CIVILEN 4350 |
| CIVILEN 5561 | Principles of Soil and Rock Mechanics | 3 | AU | CIVILEN 3540/3541 |
| CIVILEN 5571 | Principles of Foundations Analysis | 3 | SP | (can be taken concurrently) CIVILEN 3540 and 3541; and CIVILEN 5561; or permission of Instructor |
| CIVILEN 5810 | Construction Safety & Forensics | 3 | SP | CIVILEN 2810; or permission of instructor |
| CIVILEN 5820 | Construction Estimating | 3 | AU | CIVILEN 2810; or permission of instructor |
| CIVILEN 5830 | Construction Scheduling | 3 | SP | CIVILEN 2810; or permission of instructor |
| CIVILEN 5840 | Construction Contracts and Claims | 3 | SP | CIVILEN 2810; or permission of instructor |
| CIVILEN 5860H | Sustainable Ancient Constructed Facilities | 3 | AU18 (only) | Honors standing; or permission of instructor |
| MECHENG 5144 | Engineering Fracture Mechanics | 3 | SP | MECHENG 2020 or 2040; and MATH 2177, 2174 or 2415 |

*\*Courses may be used towards either the CE requirements or the TE requirements, but not both.*

1. Transportation and Geodetic Engineering

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| **Course #** | **Course Title** | **Cr Hrs.** | **Offered** | **Prerequisites** |
| CIVILEN 5001 | Introduction to Geographic Information  Systems | 4 | AU | CIVILEN 2050 and senior standing; or permission of instructor |
| CIVILEN 5300 | Airport Planning and Design | 3 | SP | Aviation 3000; or permission of instructor |
| CIVILEN 5410 | Engineering Surveying | 3 | AU | CIVILEN 2410; or permission of instructor |
| CIVILEN 5420 | Remote Sensing of Environment | 3 | SP | CIVILEN 2410; or permission of instructor |
| CIVILEN 5422 | Terrain Analysis | 3 | AU | CIVILEN 2050; or permission of instructor |
| CIVILEN 5441 | Introduction to GPS: Theory and Applications | 3 | SP | MATH 1172 or 2153; and junior or senior standing; or permission of instructor |
| CIVILEN 5461 | Geospatial Numerical Analysis | 4 | AU | CIVILEN 2410 |
| CIVILEN 5700 | Urban Transportation Demand Forecasting | 3 | AU | CIVILEN 3700; or permission of instructor |
| CIVILEN 5720 | Transportation Engineering Data Collection Studies | 3 | AU | CIVILEN 3700; or permission of instructor |
| CIVILEN 5730 | Highway Location and Design | 3 | SP | CIVILEN 3700; or permission of instructor |
| CIVILEN 5740 | Design and Operation of Road Traffic Facilities | 3 | SP | CIVILEN 3700; or permission of instructor |
| CIVILEN 5750 | Instrumentation, Signals, and Control in Transportation Applications | 3 | AU (even) | CIVILEN 3700; or permission of instructor |
| CIVILEN 5760 | Network Metrics and Control in Transportation Systems | 3 | AU (odd) | CIVILEN 3700; or permission of instructor |
| CIVILEN 5770 | Urban Public Transportation | 3 | SP | CIVILEN 3700; or permission of instructor |

1. Water Resources and Environmental Engineering

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| **Course #** | **Course Title** | **Cr Hrs.** | **Offered** | **Prerequisites** |
| CIVILEN 5130 | Applied Hydrology | 3 | AU | CIVILEN 3160 |
| CIVILEN 5220 | Open Channel Hydraulics | 3 | SP | CIVILEN 3160; and MATH 2177 or 2415 and 2568 |
| CIVILEN 5230 | Transport Phenomena In Water Resources Engineering | 3 | SP | CIVILEN 3160; and MATH 2173, 2177, or 2415  *Course not currently in rotation* |
| CIVILEN 5240 | Groundwater Engineering | 3 | SP (even) | CIVILEN 3130; or permission of instructor  *Course not currently in rotation* |
| ENVENG 3210 | Environmental Engineering Unit Operations | 3 | SP | CHEM 1220 or 1250; and CIVILEN 3130; or permission of instructor |
| ENVENG 4600 | Assessment for Human Rights and Sustainability | 3 | AU | None |
| ENVENG 5110 | Environmental Engineering Bioprocesses | 3 | AU | ENVENG 3200 |
| ENVENG 5120 | Bioremediation of Groundwater and Soil | 3 | SP (even) | A course in microbiology; or permission of instructor |
| ENVENG 5140 | Air Quality in Engineering | 3 | SP | CHEM 1220 or 1250; and MATH 2177, 2174 or 2415; or permission of instructor |
| ENVENG 5170 | Sustainability and Pollution Prevention Practices | 3 | SP | ENVENG 3200; or permission of instructor |
| ENVENG 5195 | Engineering Design for Environmental Health | 3 | AU | MATH 1151 or 1161; and CHEM 1210 or 1250; or permission of instructor |
| ENVENG 5217 | Applied Mathematical Ecology | 3 | SP (even) | CIVILEN 2060; and ENGR 1221; or permission of instructor |
| ENVENG 5218 | Measurement and Modeling of Climate Change, the Atmospheric Boundary Layer and Ecosystem Fluxes | 3 | SP (odd) | CIVILEN 2060; and ENGR 1221; or permission of instructor |
| ENVENG 5410 | Hazardous Waste Management and Remediation | 2 | AU (odd) | ENVENG 3210; or permission of instructor |
| ENVENG 5600 | Science, Engineering, and Public Policy (cross-listed with PUBAFRS) | 3 | SP | Junior or senior standing; or permission of instructor |
| FABENG 5310 | Ecological Engineering and Science  (cross-listed in ENR and ENVENG) | 3 | SP | At least one course in biology, ecology, engineering or geology; and junior standing |
| PUBHEHS 7365 | Principles of Risk Assessment | 3 | SP | Grad standing or permission of the instructor |

Additional Technical Electives – No more than three (3) credit hours from these options

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| **Course #** | **Course Title** | **Cr Hrs** | **Offered** | **Prerequisites** |
| CIVILEN/ENVENG 2193 | Independent Study | 3 | AU/SP | Permission of instructor |
| CIVILEN 4191.0X | Internship Course | 1or 2 | AU/SP/SU | Permission of instructor |
| CIVILEN/ENVENG 4193 | Independent Study | 3 | AU/SP | Permission of instructor |
| CIVILEN /ENVENG 4998 | Undergraduate Research, No Thesis | 3 | AU/SP | Permission of instructor |
| CIVILEN /ENVENG 4999 | Undergraduate Research with Thesis | 3 | AU/SP | Permission of instructor |
| CIVILEN 5610.01 | Sustainable Infrastructure for Developing Rural Communities | 3 | SP | Permission of instructor |
| CIVILEN /ENVENG 5880 | Seminar | 3 | AU/SP | Permission of instructor |
| ENGR 5050 | Humanitarian Engineering | 3 | SP | ENGR 1182 or 1282H; or permission of instructor |
| MECHENG 3501 | Introduction to Engineering Thermodynamics | 3 | AU/SP | MECHENG 2850; and MECHENG 2900; and CHEM 1220 or 1250; or permission of instructor |
| NUCLREN 4505 | Introduction to Nuclear Science and Engineering (cross-listed in MECHENG) | 3 | SP | MATH 2173, 2177 or 2415; and PHYSICS 1251; or permission of instructor |

**Additional Science Electives**

Civil Engineering students are required to complete a **minimum of 8 semester credit hours of additional science elective credit** hours from the following list of approved courses. At least one course must be taken from Group A. The balance of courses may be taken from Group A or Group B.

**Additional Science Electives Group A**

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| --- | --- | --- | --- | --- |
| **Course #** | **Course Title** | **Cr Hrs.** | **Offered** | **Prerequisites** |
| BIOLOGY 1113 | Biological Sciences: Energy Transfer and Development | 4 | AU/SP | MATH 1150 or above; (can be taken concurrently) CHEM 1110, 1210, 1610, or 1910H; or permission of course coordinator |
| EARTHSC 1121 | The Dynamic Earth | 4 | AU/SP | MATH 1075 or above |
| ENR 3000 | Soil Science | 3 | AU/SP | None |
| ENR 3001 | Soil Science Laboratory | 1 | AU/SP | (can be taken concurrently) ENR 3000 |
| GEOG 2960 | Introduction to Physical Geography | 4 | AU/SP | None |

**Additional Science Electives Group B**

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| --- | --- | --- | --- | --- |
| **Course #** | **Course Title** | **Cr Hrs.** | **Offered** | **Prerequisites** |
| BIOLOGY 1114 | Biological Sciences: Form, Function, Diversity, and Ecology | 4 | AU/SP/  SU | MATH 1150 or above; (can be taken concurrently) CHEM 1110, 1210, 1610, or 1910H; or permission of course coordinator |
| CHEM 1220 | General Chemistry II | 5 | AU/SP/  SU | CHEM 1210, 1250, 1610, or 1910H; and a grade of a C- or above in MATH 1148 or above |
| PHYSICS 1251 | E&M, Optics, Modern Physics | 5 | AU/SP | PHYSICS 1250, 1250H, or 1260; and MATH 1151 or above; or permission of instructor; (can be taken concurrently) and Math 1151, 1161, or 1172 |