Degrees Offered

- Bachelor of Science in Civil Engineering (B.S.C.E.)

Nature of the Program

Civil engineering historically encompassed all engineering endeavors needed to provide the infrastructure for society to function. Because of its origin and history, civil engineering still embraces a wide variety of technological areas. These include:

- Construction
- Environmental and Water Resources
- Geotechnical
- Structures
- Transportation

Civil engineers work with problems that directly impact the health and economic vitality of people and communities. These problems include waste disposal, environmental pollution, transportation systems analysis and design, water resource development, and the design, construction, and rehabilitation of constructed facilities such as dams, bridges, buildings, and highways.

Thus, the challenges and opportunities for a civil engineer lie in combining technical competence with a human concern for the applications of technology. To help students to understand their role in the community, to be effective in working with design teams involving other engineers and other professionals, and to be effective in written and spoken communications, the curriculum attempts to give a meaningful educational experience in the humanities, social studies, English, and economics.

The goal of the undergraduate curriculum in civil engineering is to prepare graduate civil engineers to meet the present and the future infrastructural and environmental needs of society. This requires an education based on scientific and engineering fundamentals as well as one that incorporates experience in engineering design using modern technology. Because the systems they design impact the public directly, civil engineers must be aware of the social and environmental consequences of their designs. Graduates must be prepared to work and communicate with other professionals in a variety of associations and organizations. Ethics and life-long learning are essential components in the education of civil engineers.

During the course of study, civil engineering students are given a solid grounding in mathematics, physics, and chemistry. Added to this is extensive development of the fundamentals of materials science, construction, water and environmental, soils, structural, and transportation systems engineering. This broad base of knowledge is provided to assure that civil engineers are educated in all branches of the profession and to permit continuous learning throughout a professional lifetime. Throughout the program, each student works with an academic advisor in the selection of electives. Specialization in one or more of the branches of civil engineering is possible by selection of a sequence of technical electives during the junior and senior years.

The Bachelor of Science in Civil Engineering (B.S.C.E.) is accredited by the Engineering Accreditation Commission (EAC) of ABET, http://www.abet.org.

Program Educational Objectives

- The graduates will be successful in their professional careers as civil engineers in industry, public agencies, and/or post-graduate education.
- The graduates will continue to develop professionally and serve in leadership roles.
- The graduates will be successful in demonstrating their obligations to the profession, to their employer, and to society.

Major Learning Outcomes

CIVIL ENGINEERING

Upon graduation, all Bachelor of Science in Civil Engineering students will have:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. An ability to communicate effectively with a range of audiences
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

FACULTY

CHAIR
- Hema J. Siriwardane - Ph.D. (Virginia Polytechnic Institute and State University)
  Geomechanics/geotechnical engineering, Finite element method, Computer applications

PROFESSORS
- Hung-Liang (Roger) Chen - Ph.D. (Northwestern University)
  Structural dynamics, Structural experimentation, Dynamic soil-structure interaction, Damage in reinforced concrete structures, Nondestructive evaluation, Concrete
- Hota GangaRao - Ph.D., P.E. (North Carolina State University)
  Maurice A. and Jo Ann Wadsworth Distinguished Professor, Director, Constructed Facilities Center. Director, NSF Center for Integration of Composites into Infrastructure, Mathematical modeling of engineering systems, Bridge engineering, Composite material characterization and implementation
- Udaya B. Halabe - Ph.D. (Massachusetts Institute of Technology)
  Nondestructive evaluation and in-situ condition assessment of structures and materials, Elastic and electromagnetic (radar) wave propagation, Structural analysis and design, Structural dynamics and wind/earthquake resistant design
- Lian-Shin Lin - Ph.D. (Purdue University)
  Physicochemical and biological treatment, Innovative wastewater technologies, Emerging contaminants, sustainable development, Watershed pollution
- David R. Martinelli - Ph.D. (University of Maryland)
  Transportation engineering, Traffic operations, Systems analysis, Infrastructure management
- Radhey Sharma - Ph.D. (Oxford)
  Sustainable infrastructure, Geotechnical engineering & geoenvironmental, Energy engineering
- Hema J. Siriwardane - Ph.D. (Virginia Polytechnic Institute and State University)
  Geomechanics/geotechnical engineering, Finite element method, Computer applications
- John P. Zaniewski - Ph.D. (University of Texas)
  Asphalt Technology Professor, Pavement materials, Design, Construction, Maintenance, Infrastructure management

ASSOCIATE PROFESSORS
- Omar I. Abdul-Aziz - Ph.D. (University of Minnesota, Twin Cities)
  Ecological Water Resources Engineering, Scaling of Hydro-Ecological and Biochemical Variables, Modeling of Stream Water Quality and Ecosystem Carbon, Fluid Mechanics, Hydrology
- Karl Barth - Ph.D. (Purdue University)
  Jack H. Samples Distinguished Professor of Structures, Steel structures, Bridge design and rehabilitation, Connections, Stability analysis, Experimental mechanics
- Fei Dai - Ph.D. (Hong Kong Polytechnic University)
  Constructions Engineering, Construction Management, Construction Information Technologies
- Leslie Clark Hopkinson - Ph.D. (Virginia Polytechnic Institute and State University)
  Surface hydrology, Environmental hydraulics, Ecological engineering, River mechanics
- Antarpreet Jutla - Ph.D. (Tufts University)
  Water Resources, Hydrology & human health, Remote sensing, Issues of scales in hydroclimatic processes
- John D. Quaranta - Ph.D. (West Virginia University)
  Geotechnical/geoenvironmental engineering, Soil testing and characterization, Soil and mine waste dewatering, Geosynthetics, Soil and groundwater remediation

ASSISTANT PROFESSORS
- Kakan Dey - Ph.D. (Clemson University)
  Intelligent Transportation Infrastructure Design and Analysis, Connected and Automated Vehicle Technology, Traffic Operations, Big Data Analytics for Transportation Data Management, Artificial Intelligence in Transportation
- Seung-Ho Hong - Ph.D. (Georgia Institute of Technology)
  River Engineering, Fluid Mechanics, Sediment Transport, Experimental Techniques in Engineering
- Dimitra Pyrialakou - Ph.D. (Purdue University)
Transportation Engineering, Transportation Planning and Evaluation, Public and Rail Transportation, Airport Operations, Transportation Econometrics, and Transportation Engineering Education

- P.V. Vijay - Ph.D. (West Virginia University)
  Concrete Structures; P Composite Structures for Bridges, Buildings, and Pavements; Aging of Structures and Rehabilitation, Recycled Polymers for Infrastructure, Analytical Modeling

- Yoqing Yoon - Ph.D. (Purdue University)
  Infrastructure Asset Management, Risk Management in Construction, Project Management and Control, Construction Equipment Management

RESEARCH ASSISTANT PROFESSORS

- Rufieng Liang - Ph.D. (Chinese Academy of Sciences Institute of Chemistry)
  Fiber Reinforced Polymer Composites, Engineering Plastics, Green Materials, Sustainable Infrastructure

PROFESSORS EMERITUS

- Ronald W. Eck - Ph.D. (Clemson University)
- W. Joseph Head - Ph.D. (Purdue University)
- Larry D. Luttrell - Ph.D. (Cornell University)
- William A. Sack - Ph.D. (Michigan State University)

ASSOCIATE PROFESSORS EMERITUS

- Robert N. Eli - Ph.D. (University of Iowa)
- Darrell R. Dean Jr. - Ph.D. (Purdue University)

Curriculum in Civil Engineering

General Education Foundations

Please use this link to view a list of courses that meet each GEF requirement. (http://registrar.wvu.edu/gef)

NOTE: Some major requirements will fulfill specific GEF requirements. Please see the curriculum requirements listed below for details on which GEFs you will need to select.

<table>
<thead>
<tr>
<th>General Education Foundations</th>
<th>3-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1 - Composition &amp; Rhetoric</td>
<td></td>
</tr>
<tr>
<td>ENGL 101</td>
<td></td>
</tr>
<tr>
<td>&amp; ENGL 102</td>
<td></td>
</tr>
<tr>
<td>or ENGL 103</td>
<td></td>
</tr>
<tr>
<td>Introduction to Composition and Rhetoric and Composition, Rhetoric, and Research Accelerated Academic Writing</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>General Education Foundations</th>
<th>4-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>F2A/F2B - Science &amp; Technology</td>
<td></td>
</tr>
<tr>
<td>F3 - Math &amp; Quantitative Reasoning</td>
<td>3-4</td>
</tr>
<tr>
<td>F4 - Society &amp; Connections</td>
<td>3</td>
</tr>
<tr>
<td>F5 - Human Inquiry &amp; the Past</td>
<td>3</td>
</tr>
<tr>
<td>F6 - The Arts &amp; Creativity</td>
<td>3</td>
</tr>
<tr>
<td>F7 - Global Studies &amp; Diversity</td>
<td>3</td>
</tr>
<tr>
<td>F8 - Focus (may be satisfied by completion of a minor, double major, or dual degree)</td>
<td>9</td>
</tr>
</tbody>
</table>

Total Hours | 31-37 |

Please note that not all of the GEF courses are offered at all campuses. Students should consult with their advisor or academic department regarding the GEF course offerings available at their campus.

Curriculum Requirements

To receive a degree of bachelor of science in civil engineering, a student must meet the University’s undergraduate degree requirements, take all the courses indicated below, and attain a GPA of 2.25 or better in all civil engineering courses, in all WVU courses, and overall. If a civil engineering course is repeated, only the last grade received is used to compute the major GPA, and the course credit hours are counted only once. This requirement assures that the student has demonstrated overall competence in the major.

Freshman Engineering Requirements

<p>| ENGR 101 Engineering Problem Solving 1 | 2 |
| Engineering Problem Solving:           | 3 |
| CHE 102 Introduction to Chemical Engineering |    |</p>
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGR 102</td>
<td>Engineering Problem-Solving 2</td>
</tr>
<tr>
<td>ENGR 103</td>
<td>Introduction to Nanotechnology Design</td>
</tr>
<tr>
<td>MAE 102</td>
<td>Introduction to Mechanical and Aerospace Design</td>
</tr>
<tr>
<td>ENGR 191</td>
<td>First-Year Seminar</td>
</tr>
</tbody>
</table>

**Required Courses (minimum grade of C- required)**

Calculus I (GEF 3): 4
- MATH 155 Calculus 1
- MATH 153 Calculus 1a with Precalculus
  & MATH 154 and Calculus 1b with Precalculus
- MATH 156 Calculus 2 (GEF 8)
- MATH 251 Multivariable Calculus
- MATH 261 Elementary Differential Equations
- CHEM 115 Fundamentals of Chemistry
  & 115L and Fundamentals of Chemistry 1 - Laboratory (GEF 2B)
- PHYS 111 General Physics (GEF 8)
- MAE 241 Statics
- MAE 242 Dynamics
- MAE 243 Mechanics of Materials

Other Required Courses

- CE 201 Introduction to Civil Engineering
- CE 210 Introduction to Computer Aided Design and Drafting for Civil Engineers
- CE 301 Engineering Professional Development
- CE 321 Fluid Mechanics for Civil Engineers
- CE 479 Integrated Civil Engineering Design-Capstone
- ECON 201 Principles of Microeconomics
- ENGL 305 Technical Writing (Fulfills Writing and Communications Skills Requirement)
- IENG 377 Engineering Economy
- STAT 215 Introduction to Probability and Statistics

Choose one of the following (GEF 8): 4
- PHYS 112 General Physics
- CHEM 116 Fundamentals of Chemistry
  & 116L and Fundamentals of Chemistry 2 - Laboratory
- BIOL 115 Principles of Biology
  & BIOL 116 and Principles of Biology Laboratory

Civil Engineering Core Courses

- CE 332 Introduction to Transportation Engineering
- CE 347 Introduction to Environmental Engineering
- CE 351 Introductory Soil Mechanics
- CE 361 Structural Analysis 1

CE Design Electives

Choose two of the following: 6
- CE 411 Pavement Design
- CE 415 Flexible Pavements
- CE 431 Highway Engineering
- CE 439 Traffic Engineering and Operations
- CE 447 Environmental Engineering Design
- CE 451 Foundation Engineering
- CE 453 Earthwork Design
- CE 462 Reinforced Concrete Design
- CE 463 Steel Design
- CE 464 Timber Design

CE Open Electives: **

Choose five of the following: 15
<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 305</td>
<td>Introduction to Geomatics</td>
</tr>
<tr>
<td>CE 310</td>
<td>Civil Engineering Materials</td>
</tr>
<tr>
<td>CE 322</td>
<td>Hydrotechnical Engineering</td>
</tr>
<tr>
<td>CE 413</td>
<td>Construction Methods</td>
</tr>
<tr>
<td>CE 414</td>
<td>Construction Engineering</td>
</tr>
<tr>
<td>CE 416</td>
<td>Advanced Concrete Materials</td>
</tr>
<tr>
<td>CE 420</td>
<td>Computational Fluid Mechanics</td>
</tr>
<tr>
<td>CE 425</td>
<td>Engineering Hydrology</td>
</tr>
<tr>
<td>CE 427</td>
<td>Water Resources Engineering</td>
</tr>
<tr>
<td>CE 433</td>
<td>Urban Transportation Planning and Design</td>
</tr>
<tr>
<td>CE 435</td>
<td>Railway Engineering</td>
</tr>
<tr>
<td>CE 436</td>
<td>Pedestrian/Bike Transportation</td>
</tr>
<tr>
<td>CE 443</td>
<td>Environmental Science and Technology</td>
</tr>
<tr>
<td>CE 445</td>
<td>Properties of Air Pollutants</td>
</tr>
<tr>
<td>CE 461</td>
<td>Structural Analysis 2</td>
</tr>
<tr>
<td>CE 493</td>
<td>Special Topics</td>
</tr>
<tr>
<td>CE 495</td>
<td>Independent Study</td>
</tr>
<tr>
<td>CE 497</td>
<td>Research</td>
</tr>
<tr>
<td>SAFM 470</td>
<td>Managing Construction Safety</td>
</tr>
</tbody>
</table>

**Engineering/Math/Science Electives ***

Choose three of the following:

- CHEM 215 & 215L: Introductory Analytical Chemistry and Introductory Analytical Chemistry Laboratory
- AEM 341: General Microbiology
- AEM 401: Environmental Microbiology
- GEOG 350: Geographic Information Systems and Science
- GEOL 342: Structural Geology for Engineers
- GEOL 488: Environmental Geochemistry
- IENG 331: Computer Applications in Industrial Engineering
- IENG 350: Introduction to Operations Research
- IENG 360: Human Factors Engineering
- IENG 455: Simulation by Digital Methods
- MAE 316: Analysis-Engineering Systems
- MAE 320: Thermodynamics
- MAE 335: Incompressible Aerodynamics
- MAE 423: Heat Transfer
- MAE 432: Engineering Acoustics
- MAE 446: Mechanics of Composite Materials
- MAE 473: Bioengineering
- MATH 343: Introduction to Linear Algebra
- MATH 375: Applied Modern Algebra
- MATH 420: Numerical Analysis 1
- MATH 441: Applied Linear Algebra
- MATH 456: Complex Variables
- MATH 465: Partial Differential Equations
- MINE 306: Mineral Property Evaluation
- PHYS 331: Theoretical Mechanics 1
- STAT 312: Intermediate Statistical Methods
- STAT 313: Introductory Design and Analysis
- STAT 331: Sampling Methods
### Additional Requirements

**General Science Elective (Select One)**

- **AGRN 202 & AGRN 203**
  - Principles of Soil Science and Principles of Soil Science Laboratory
- **Biol 101 & 103**
  - General Biology and General Biology Laboratory
- **Biol 102 & 104**
  - General Biology and General Biology Laboratory
- **Chem 233 & 235**
  - Organic Chemistry and Organic Chemistry Laboratory
- **Biol 105**
  - Environmental Biology
- **Biol 115 & 116**
  - Principles of Biology and Principles of Biology Laboratory
- **Biol 302**
  - Biometry
- **Biol 446**
  - Freshwater Ecology
- **Chem 116 & 116L**
  - Fundamentals of Chemistry and Fundamentals of Chemistry 2 - Laboratory
- **CS 110**
  - Introduction to Computer Science
- **Aem 341**
  - General Microbiology
- **Aem 401**
  - Environmental Microbiology
- **Geog 350**
  - Geographic Information Systems and Science
- **Geog 415**
  - Global Environmental Change
- **Geog 455**
  - Introduction to Remote Sensing
- **Geol 203**
  - Physical Oceanography
- **Geol 342**
  - Structural Geology for Engineers
- **Phys 112**
  - General Physics
- **Phys 211**
  - Introduction to Mathematical Physics
- **Phys 313**
  - Introductory Electronics
- **Phys 314**
  - Introductory Modern Physics
- **Phys 321**
  - Optics
- **Phys 331**
  - Theoretical Mechanics 1
- **Phys 333**
  - Electricity and Magnetism 1

**Engineering Elective (outside CEE Dept.):** Any 200, 300, 400 level Statler College course not otherwise used except Civil Engineering courses, Computer Science courses and IENG 213.

**GEF Electives 1, 5, 6, 7**

**Total Hours**

132

* A grade of D- is permitted in MAE 242 only. Any courses transferred from outside of WVU must be a C- or better.

** Any CE Design Electives that are not otherwise used can also be used.

*** Any CE 400 level course not otherwise used can also be used.

### Suggested Plan of Study

#### First Year

**Fall**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math 155 (GEF 3)</td>
<td>4</td>
</tr>
<tr>
<td>Engr 101</td>
<td>3</td>
</tr>
<tr>
<td>Engr 191</td>
<td>4</td>
</tr>
<tr>
<td>Chem 115 &amp; 115L (GEF 2)</td>
<td>3</td>
</tr>
<tr>
<td>Eng 101 (GEF 1)</td>
<td>3</td>
</tr>
<tr>
<td>GEF 5</td>
<td>3</td>
</tr>
</tbody>
</table>

**Spring**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math 156 (GEF 8)</td>
<td>4</td>
</tr>
<tr>
<td>Engr 102</td>
<td>3</td>
</tr>
<tr>
<td>Phys 111 (GEF 8)</td>
<td>4</td>
</tr>
<tr>
<td>GEF 6</td>
<td>3</td>
</tr>
<tr>
<td>GEF 7</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Hours**

17
## Second Year

### Fall
- MAE 241
- MATH 251
- CE 210
- CE 201
- ENGL 102 (GEF 1)

Select one of the following (GEF 8):
- CE 332
- CHEM 116
- BIOL 115

### Hours
- 4
- 4

### Spring
- 3 MAE 243
- 4 MAE 242
- 2 MATH 261
- 1 ENGL 305
- 3 Select one of the following:

Select one of the following (GEF 8):
- PHYS 112
- CE 347

### Hours
- 3
- 3

### Total
- 17
- 17

## Third Year

### Fall
- CE 321
- Two CE Core Classes
- STAT 215
- ECON 201 (GEF 4)

### Hours
- 3 CE Core Class
- 8 CE 301
- 3 Two CE Open Electives
- 3 CE Design Elective

### Spring
- 1
- 6

### Hours
- 3 ENGR/MATH/Science Elective

### Total
- 17
- 17

## Fourth Year

### Fall
- CE Design Elective
- Two CE Open Electives
- General Science Elective
- IENG 377

### Hours
- 3 CE Open Elective
- 6 CE 479
- 3 Two ENGR/MATH/Science Electives
- 3 ENGR Elective (outside CEE Dept.)

### Hours
- 3
- 6

### Total
- 15
- 15

Total credit hours: 132

## Major Learning Outcomes

### CIVIL ENGINEERING

Upon graduation, all Bachelors of Science students in Civil Engineering will:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. An ability to communicate effectively with a range of audiences
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

These outcomes are achieved via rigorous individual courses in all basic areas of chemical engineering, the natural and life sciences, mathematics, humanities, and social sciences. A flexible electives program allows specialization in areas such as environment and safety, polymers and materials, biological processes, and energy processes.

The civil engineering department uses an outcomes-assessment plan for continuous program improvement. The design projects, in conjunction with yearly interviews and questionnaires, provide the measures of learning outcomes. These outcomes-assessment results provide feedback to the faculty to improve teaching and learning processes.
Curriculum for a Dual Degree in Mining Engineering and Civil Engineering

This curriculum allows students to simultaneously pursue B.S. degrees in mining engineering and civil engineering by completing additional courses. A suggested schedule for the dual curriculum in mining engineering and civil engineering is shown below.

To receive the degrees of bachelor of science in mining engineering and bachelor of science in civil engineering, a student must take all of the courses indicated below and achieve a grade point average of 2.25 or better for all civil engineering courses attempted and a grade point average of 2.25 in all mining engineering courses attempted, except for those courses in which a grade of W was received. If a course is repeated, only the last grade received is counted in computing the grade point average, and the course credit hours are counted only once. This requirement assures that the student has demonstrated overall competence in the chosen major.

Undergraduate Student Minimum Performance Policy

All civil and environmental engineering students at WVU, including transfer students and second degree students, must complete each tracking course with a grade of C- or better, with the exception that one D- in a course taken at WVU is permitted. Any tracking course transferred from outside of WVU must be a C- or better. Only the following civil engineering courses may be taken prior to completion of the minimum performance policy: CE 201, CE 210, CE 305, CE 332, CE 347.

It is important for students to take courses in the order specified as much as possible; all prerequisites and concurrent requirements must be observed. A typical dual B.S.Min.E. and B.S.C.E. degree program that completes degree requirements in five years is as follows:

Mining/Civil Engineering Curriculum Requirements

Students must complete a minimum of 152 credit hours to graduate - the total at the bottom reflects all possible course combinations.

### Tracking Courses

Minimum grade of C- required.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 115 &amp; 115L</td>
<td>Fundamentals of Chemistry and Fundamentals of Chemistry 1 - Laboratory (GEF 2)</td>
<td>4</td>
</tr>
<tr>
<td>MAE 241</td>
<td>Statics</td>
<td>3</td>
</tr>
<tr>
<td>MAE 242</td>
<td>Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>MAE 243</td>
<td>Mechanics of Materials</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Select one of the following (GEF 3):</td>
<td></td>
</tr>
<tr>
<td>MATH 155</td>
<td>Calculus 1</td>
<td>4</td>
</tr>
<tr>
<td>MATH 153 &amp; MATH 154</td>
<td>Calculus 1a with Precalculus and Calculus 1b with Precalculus</td>
<td>4</td>
</tr>
<tr>
<td>MATH 156</td>
<td>Calculus 2 (GEF 8)</td>
<td>4</td>
</tr>
<tr>
<td>MATH 251</td>
<td>Multivariable Calculus</td>
<td>4</td>
</tr>
<tr>
<td>MATH 261</td>
<td>Elementary Differential Equations</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 111</td>
<td>General Physics (GEF 8)</td>
<td>4</td>
</tr>
</tbody>
</table>

### Required Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 201</td>
<td>Introduction to Civil Engineering</td>
<td>1</td>
</tr>
<tr>
<td>CE 301</td>
<td>Engineering Professional Development</td>
<td>1</td>
</tr>
<tr>
<td>CE 321</td>
<td>Fluid Mechanics for Civil Engineers</td>
<td>3</td>
</tr>
<tr>
<td>CE 423</td>
<td>Water System Design</td>
<td>3</td>
</tr>
<tr>
<td>CE 479</td>
<td>Integrated Civil Engineering Design-Capstone</td>
<td>3</td>
</tr>
<tr>
<td>ECON 201</td>
<td>Principles of Microeconomics (GEF 4)</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 101</td>
<td>Engineering Problem Solving 1</td>
<td>2</td>
</tr>
<tr>
<td>ENGR 102</td>
<td>Engineering Problem-Solving 2</td>
<td>3</td>
</tr>
<tr>
<td>ENGR 191</td>
<td>First-Year Seminar</td>
<td>1</td>
</tr>
<tr>
<td>GEOL 101</td>
<td>Planet Earth</td>
<td>3</td>
</tr>
<tr>
<td>GEOL 102</td>
<td>Planet Earth Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>GEOL 342</td>
<td>Structural Geology for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>IENG 377</td>
<td>Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td>MAE 320</td>
<td>Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>MINE 201</td>
<td>Mine Surveying</td>
<td>3</td>
</tr>
<tr>
<td>MINE 205</td>
<td>Underground Mining Systems</td>
<td>3</td>
</tr>
<tr>
<td>MINE 206</td>
<td>Surface Mining Systems</td>
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<td>Course Code</td>
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<tr>
<td>MINE 261</td>
<td>Engineering Computer Aided Design</td>
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<tr>
<td>MINE 306</td>
<td>Mineral Property Evaluation</td>
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<tr>
<td>MINE 331</td>
<td>Mine Ventilation</td>
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<td>MINE 382</td>
<td>Mine Power Systems</td>
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<tr>
<td>MINE 411</td>
<td>Rock Mechanics/Ground Control</td>
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<tr>
<td>MINE 427</td>
<td>Coal Preparation</td>
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<tr>
<td>MINE 471</td>
<td>Mine and Safety Management</td>
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<tr>
<td>MINE 480</td>
<td>Multidisciplinary Team Project</td>
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<tr>
<td>MINE 483</td>
<td>Mine Design-Exploration Mapping</td>
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<tr>
<td>PHYS 112</td>
<td>General Physics (GEF 8)</td>
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<tr>
<td>STAT 215</td>
<td>Introduction to Probability and Statistics</td>
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### Civil Engineering Core Courses

<table>
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<tr>
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<tbody>
<tr>
<td>CE 332</td>
<td>Introduction to Transportation Engineering</td>
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<tr>
<td>CE 347</td>
<td>Introduction to Environmental Engineering</td>
<td>4</td>
</tr>
<tr>
<td>CE 351</td>
<td>Introductory Soil Mechanics</td>
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<tr>
<td>CE 361</td>
<td>Structural Analysis 1</td>
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### Civil Engineering Design Electives

Select from the following: 6

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CE 411</td>
<td>Pavement Design</td>
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<tr>
<td>CE 415</td>
<td>Flexible Pavements</td>
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<tr>
<td>CE 447</td>
<td>Environmental Engineering Design</td>
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<td>CE 451</td>
<td>Foundation Engineering</td>
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<td>CE 453</td>
<td>Earthwork Design</td>
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<td>CE 462</td>
<td>Reinforced Concrete Design</td>
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<td>CE 463</td>
<td>Steel Design</td>
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<tr>
<td>CE 464</td>
<td>Timber Design</td>
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### Civil Engineering Electives

Select from the following: 3

<table>
<thead>
<tr>
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<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CE 305</td>
<td>Introduction to Geomatics</td>
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<tr>
<td>CE 310</td>
<td>Civil Engineering Materials</td>
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<td>CE 413</td>
<td>Construction Methods</td>
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<tr>
<td>CE 414</td>
<td>Construction Engineering</td>
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<tr>
<td>CE 416</td>
<td>Advanced Concrete Materials</td>
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<td>CE 420</td>
<td>Computational Fluid Mechanics</td>
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<td>CE 425</td>
<td>Engineering Hydrology</td>
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<tr>
<td>CE 427</td>
<td>Water Resources Engineering</td>
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<td>CE 433</td>
<td>Urban Transportation Planning and Design</td>
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<td>CE 435</td>
<td>Railway Engineering</td>
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<td>Pedestrian/Bike Transportation</td>
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<td>CE 443</td>
<td>Environmental Science and Technology</td>
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<td>CE 445</td>
<td>Properties of Air Pollutants</td>
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<td>CE 461</td>
<td>Structural Analysis 2</td>
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<td>CE 493</td>
<td>course (approved by Advisor)</td>
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<td>CE 495</td>
<td>Independent Study</td>
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<tr>
<td>SAFM 470</td>
<td>Managing Construction Safety</td>
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GEF Electives 1, 5, 6, 7 | 15

Total Hours | 152

* A grade of D- is permitted in MAE 242 only. Any courses transferred from outside of WVU must be a C- or better.
# MINE and CE Suggested Plan of Study

## First Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Hours</th>
<th>Spring</th>
<th>Hours</th>
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<tbody>
<tr>
<td>CHEM 115  &amp; 115L (GEF 2)</td>
<td>4 ENGR 102</td>
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<tr>
<td>ENGL 101 (GEF 1)</td>
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<tr>
<td>ENGR 101</td>
<td>2 GEOl 102</td>
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<tr>
<td>ENGR 191</td>
<td>1 MATH 156 (GEF 8)</td>
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<td>MATH 155 (GEF 3)</td>
<td>4 PHYS 111 (GEF 8)</td>
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## Second Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Hours</th>
<th>Spring</th>
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<tbody>
<tr>
<td>CE 201</td>
<td>1 ENGL 102 (GEF 1)</td>
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<tr>
<td>MAE 241</td>
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<td>MATH 251</td>
<td>4 MATH 261</td>
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<td>MINE 201</td>
<td>3 MINE 206</td>
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<tr>
<td>MINE 205</td>
<td>3 PHYS 112 (GEF 8)</td>
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<td>MINE 261</td>
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## Third Year

<table>
<thead>
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<th>Fall</th>
<th>Hours</th>
<th>Spring</th>
<th>Hours</th>
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<tbody>
<tr>
<td>CE 321</td>
<td>3 Two CE Core Courses*</td>
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<tr>
<td>GEOL 342</td>
<td>3 MINE 331</td>
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<td>MAE 243</td>
<td>3 MINE 427</td>
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<td>MAE 320</td>
<td>3 MINE 480</td>
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<td>STAT 215</td>
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<td><strong>Total</strong>: 15</td>
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## Fourth Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Hours</th>
<th>Spring</th>
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<tbody>
<tr>
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<td>8 CE 301</td>
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<tr>
<td>MINE 306</td>
<td>3 Two CE Design Electives**</td>
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<td>MINE 382</td>
<td>3 GEF Elective 6</td>
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<td>CE 423</td>
<td>3 IENG 377</td>
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## Fifth Year

<table>
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<tr>
<th>Fall</th>
<th>Hours</th>
<th>Spring</th>
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<tbody>
<tr>
<td>GEF Elective 5</td>
<td>3 CE Open Elective***</td>
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<tr>
<td>ECON 201 (GEF 4)</td>
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<tr>
<td>MINE 411</td>
<td>4 GEF Elective 7</td>
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<td>MINE 471</td>
<td>3 MINE 484</td>
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<tr>
<td>MINE 483</td>
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<tr>
<td><strong>Total</strong>: 15</td>
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Total credit hours: 152

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* CE Core Classes: CE 332, CE 347, CE 351, CE 361
** CE Design Electives—any approved CE 400-level design course. See advisor for approved list
*** CE Open Electives—any approved CE 300 or CE 400-level course. See advisor for approved list.

**Notes**: Discipline substitutions:

• MINE requirement for is fulfilled through CE 322 and CE 351.
• MINE 382 fulfills requirement of CE engineering elective outside CE.
• MINE 461 is fulfilled by CE 322.
• MINE 484 fulfills CE requirement for ENGL 305.
• MINE requirement for STAT 211 is fulfilled by CE requirement of STAT 215.
• CE 321 fulfills MINE requirement for MAE 331.
• MINE technical elective and MINE Eng/Sci technical elective requirements are fulfilled by any two of the following: CE 332, CE 347, or CE 361.
• GEOL 342 fulfills requirement of CE basic science elective.
• MINE 261 substitutes for CE 210.

CE 191. First-Year Seminar. 1-3 Hours.
Engages students in Investigation of topics not covered in regularly scheduled active learning strategies that enable effective transition to college life at WVU. Students will explore school, college and university programs, policies and services relevant to academic success. Provides active learning activities that enable effective transition to the academic environment. Students examine school, college and university programs, policies and services.

CE 200. Land Surveying. 3 Hours.
PR: MATH 128. Introduction to current surveying methods and equipment as applied to mapping projects and simple construction layout. Leveling, angles and directions, distance measurements, and fundamental traverse calculations along with mapping principles are emphasized.

CE 201. Introduction to Civil Engineering. 1 Hour.
PR: ENGR 102. Overview of civil engineering disciplines and careers including structural, environmental, hydrotechnical, geotechnical and transportation engineering. Addresses the technical concepts and career opportunities in each area. Emphasis on providing guidance for success in completing undergraduate studies.

CE 210. Introduction to Computer Aided Design and Drafting for Civil Engineers. 2 Hours.
PR: ENGR 102 or consent. An introduction to computer-aided design and drafting (CADD) software for communicating design plans and specifications for civil and environmental engineering projects.

CE 273. American Society of Civil Engineers Workshop. 1 Hour.
The course provides a formal structure for meeting and conducting activities necessary to compete in competitions such as the concrete canoe, steel bridge, technical problem solving, and surveying. It does not satisfy any graduation requirement.

CE 293. Special Topics. 1-6 Hours.
PR: Consent. Investigation of topics not covered in regularly scheduled courses.

CE 301. Engineering Professional Development. 1 Hour.
PR: CE 201. Non-technical issues facing graduate engineers; career paths, job search, professional registration, legal issues, engineering ethics, professional societies, and life-long learning.

CE 305. Introduction to Geomatics. 3 Hours.
PR: CE 210. Introduction to the theory and practice of the technologies used to measure, calculate, acquire, process, and display terrain and other data for use in mapping, planning, designing, constructing, and managing the built and natural environments. (2 - 75-minute periods.).

CE 310. Civil Engineering Materials. 3 Hours.
PR: MAE 243. Physical, chemical, and molecular properties of materials commonly used in civil engineering works. Influence of these properties on the performance and use of materials.

CE 321. Fluid Mechanics for Civil Engineers. 3 Hours.
PR: MATH 261 and MAE 242. Fluid properties, statics, and kinematics; conservation laws for mass, momentum, and mechanical energy; piezometric head and grade lines; dimensional analysis and similitude; weir and orifice flow; introduction to flow in pipes and open channels. (3 hr. lecture.).

CE 322. Hydrotechnical Engineering. 3 Hours.
PR: CE 321. Flow in pipes and pipe networks; pumps; uniform and gradually varied open channel flow; design of water distribution, sanitary sewer, and storm water collection systems. (3 hr. lec.).

CE 332. Introduction to Transportation Engineering. 4 Hours.
PR: MATH 156 with a minimum grade of C-. Integrated transportation systems from the standpoint of assembly, haul, and distribution means. Analysis of transport equipment and traveled way. Power requirements, speed, stopping, capacity, economics, and route location. Future technological developments and innovations. (3 hr. lec., 3 hr. lab.).

CE 347. Introduction to Environmental Engineering. 4 Hours.
PR: WVU sections require CHEM 115 and MATH 251 with a minimum grade of C- in each, WVUIT sections require MAE 331 and CHEM 116. Introduction to physical, chemical, and biological characteristics of waters and wastewaters, and fundamental principles of water and wastewater treatment including hands-on laboratory exercises.
CE 351. Introductory Soil Mechanics. 4 Hours.
PR: WVU sections require MAE 241 and MAE 243 and MATH 261 with a minimum grade of C- in each, WVUIT sections require MAE 243 and GEOL 312. Introduction to geotechnical engineering, fundamental soil properties, classification of soils, soil compaction, permeability, compressibility, and consolidation of soils, shear strength, lateral earth pressures.

CE 361. Structural Analysis 1. 4 Hours.
PR: WVU sections require MAE 241 and MAE 243 and MATH 261 with a minimum grade of C- in each, WVUIT sections require MAE 243 and PR or CONC: MATH 251. Stability, determinacy, and equilibrium of structures; shear and bending moment diagrams of determinate and indeterminate beams and frames; analysis of trusses; displacement of planar structures by geometric and energy methods.

CE 393. Special Topics. 1-6 Hours.
PR: Consent. Investigation of topics not covered in regularly scheduled courses.

CE 411. Pavement Design. 3 Hours.
PR: WVU sections require CE 351, WVUIT sections required CE 312 and CE 331 and CE 351. Effects of traffic, soil, environment, and loads on the design and behavior of pavement. Design of pavement structures. Pavement performance and performance surveys.

CE 413. Construction Methods. 3 Hours.
PR: CE 332 or CE 347 or CE 351 or CE 361. Study of construction methods, equipment, and administration with particular emphasis on the influence of new developments in technology. (3 hr. lec.).

CE 414. Construction Engineering. 3 Hours.
PR: CE 332 or CE 347 or CE 351 or CE 361. Introduce student to the role of the civil engineer in the construction process, including critical path analysis, productivity estimation, equipment capability and selection.

CE 415. Flexible Pavements. 3 Hours.
PR: CE 310. Design, construction and maintenance of flexible pavements, including material characterization, mix design, construction methods, pavement design and evaluation, and maintenance procedures.

CE 416. Advanced Concrete Materials. 3 Hours.
PR: MAE 243. Microstructure and properties of portland cement pastes, rheology, maturity, strength properties, non-linear fracture mechanics, early age volume changes, creep and shrinkage models, transport mechanism and durability of concrete, special concretes. (3 hr. lec.).

CE 417. Infrastructure Asset Management 1. 3 Hours.
PR: CE 332 or CE 347 or CE 351 or CE 361. Integrated course that covers different strategies in supporting and sustaining civil infrastructure systems which include transportation, drinking and waste water, and energy systems. This course focuses on the maintenance stage, which broadly includes maintenance, repair, rehabilitation, and replacement, of the lifetime of an infrastructure (e.g., planning, design, construction, and operation/maintenance).

CE 420. Computational Fluid Mechanics. 3 Hours.
PR: CE 321. Use of the computer in elementary hydraulics, open channel flow, potential flow, and boundary layer flow, numerical techniques for solution of algebraic equations, ordinary differential equations, and partial differential equations. (3 hr. lec.).

CE 423. Water System Design. 3 Hours.
PR: CE 321. This course extends the student's understanding of fluid mechanics and brings it to bear on common and important areas of water system design: water distribution systems, sanitary sewer systems, and storm water collection systems.

CE 425. Engineering Hydrology. 3 Hours.
PR: WVU sections require CE 321, WVUIT sections require MAE 331. Scientific basis of the hydrologic cycle and its engineering implications; rainfall-runoff processes, hydrographs, flood routing, and statistical methods. (3 hr. lec.).

CE 427. Water Resources Engineering. 3 Hours.
PR: CE 321. Application of hydrologic and hydraulic principles in the design and analysis of water resource systems; probability concepts and economics in water resource planning, water law, reservoir operations, hydraulic structures, flood damage mitigation, hydroelectric power, and drainage. (3 hr. lec.).

CE 431. Highway Engineering. 3 Hours.
PR: WVU sections require CE 332, WVUIT sections require CE 204 and CE 331. Highway administration, economics and finance; planning and design; subgrade soils and drainage; construction and maintenance. Design of a highway. Center line and grade line projections, earthwork and cost estimates.

CE 433. Urban Transportation Planning and Design. 3 Hours.
PR: CE 332. Principles of planning and physical design of transportation systems for different parts of the urban area. Land use, social, economic, and environmental compatibilities emphasized. Evaluation and impact assessment. (3 hr. lec.).

CE 435. Railway Engineering. 3 Hours.
PR: CE 332. Development and importance of the railroad industry. Location, construction, operation, and maintenance. (3 hr. lec.).

CE 436. Pedestrian/Bike Transportation. 3 Hours.
PR: CE 332. Planning, design, operation and maintenance of pedestrian and bicycle facilities, including multi-use trails; policies to encourage non-motorized travel; traffic calming; accessibility and ADA requirements; connections to transit. (3 hr. lec.).
CE 439. Traffic Engineering and Operations. 3 Hours.
PR: CE 332. Driver and vehicular characteristics, horizontal and vertical curve design, traffic flow theory, analysis of traffic engineering data, traffic engineering studies, traffic signal analysis and design.

CE 442. Environmental Aerosol Science. 3 Hours.
PR: CE 347. This course will give an understanding of the basic principles behind aerosol generation, measurement, mechanics, and toxicity for aerosols found in the environment.

CE 443. Environmental Science and Technology. 3 Hours.
PR: CE 347. Issues of global atmospheric change, minimization and control of hazardous wastes, groundwater contamination, water pollution, air pollution, solid waste control, and management of water and energy resources. (3 hr. lec.).

CE 445. Properties of Air Pollutants. 3 Hours.
PR: CE 347. Physical, chemical, and biological behavioral properties of dusts, droplets, and gases in the atmosphere. Air pollutant sampling and analysis. Planning and operating air pollution surveys. (3 hr. lec.).

CE 447. Environmental Engineering Design. 3 Hours.
PR: CE 347. Process design of treatment/remediation systems; comparison of alternatives and preliminary cost evaluation. (2 hr. lec., 3 hr. lab.).

CE 451. Foundation Engineering. 3 Hours.
PR: CE 351. Subsurface investigations and synthesis of soil parameters for geotechnical design and analysis, concepts of shallow and deep foundation design, geotechnical design of conventional retaining walls, computerized analysis and design of soil/foundation interaction; case histories. (3 hr. lec.).

CE 453. Earthwork Design. 3 Hours.
PR: CE 351. Use of soil mechanics principles in the analysis, design and construction of earth structures. Principles of compaction and compaction control; an introduction to slope stability analysis and landslides; earth reinforcement systems, and ground improvement techniques. (3 hr. lec.).

CE 454. Geotechnical Engineering Field Methods. 3 Hours.
PR: CE 351. Soil exploration and groundwater sampling; in-situ determination of properties using split spoon, cone, dilatometer, pressure meter, and vane equipment. Instrumentation for monitoring field performance and challenges associated with exploration and monitoring in geotechnical/geoenvironmental engineering. (3 hr. lec.).

CE 461. Structural Analysis 2. 3 Hours.
PR: WVU sections require CE 361, WVUIT sections require MATH 261 and PR or CONC: (CE 462 or CE 463). Fundamental theory of statically indeterminate structures; analysis of indeterminate beams, frames, and trusses by stiffness and flexibility methods; study of influence lines for beams, frames, and trusses.

CE 462. Reinforced Concrete Design. 3 Hours.
PR: WVU sections require CE 361, WVUIT sections require PR or CONC: CE 361. Behavior and design of reinforced concrete members. Material properties, design methods and safety consideration, flexure, shear, bond and anchorage, combined flexure and axial load, footings, introduction to torsion slender columns, and pre-stressed concrete.

CE 463. Steel Design. 3 Hours.
PR: CE 361. Material properties, design of steel bridge and building systems with emphasis on connections, beams, columns, plastic design, and cost estimates.

CE 464. Timber Design. 3 Hours.
PR: CE 361. Fundamentals of modern timber design and analysis. Topics include wood properties, design of beams, columns, trusses, and other structures using dimension lumber, glue-laminated products and composites.

CE 479. Integrated Civil Engineering Design-Capstone. 3 Hours.
PR: Senior standing and a minimum grade of C in CE 411 or CE 415 or CE 431 or CE 439 or CE 447 or CE 451 or CE 453 or CE 462 or CE 463 or CE 464 or CE 465. Capstone integration of the civil engineering curriculum by comprehensive design experience to professional standards. Projects are performed in student groups under faculty supervision.

CE 490. Teaching Practicum. 1-3 Hours.
PR: Consent. Teaching practice as a tutor or assistant.

CE 491. Professional Field Experience. 1-18 Hours.
PR: Consent. (May be repeated up to a maximum of 18 hours.) Prearranged experiential learning program, to be planned, supervised, and evaluated for credit by faculty and field supervisors. Involves temporary placement with public or private enterprise for professional competence development.

CE 493. Special Topics. 1-6 Hours.
PR: Consent. Investigation of topics not covered in regularly scheduled courses.

CE 494. Seminar. 1-3 Hours.
PR: Consent. Presentation and discussion of topics of mutual concern to students and faculty.

CE 495. Independent Study. 1-6 Hours.
Faculty supervised study of topics not available through regular course offerings.

CE 496. Senior Thesis. 1-3 Hours.
PR: Consent.
CE 497. Research. 1-15 Hours.
Independent research projects.

CE 498. Honors. 1-3 Hours.
PR: Students in Honors Program and consent by the honors director. Independent reading, study or research.