## Civil Engineering (MS)

### Master of Science Degree Requirements

Students may choose from the specializations below to complete coursework within a focus area.

Degrees earned will be distributed as: “Master of Science” without specialization specifications.

### Computing & Systems Specialization

- Select at least five courses in the CE department

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
<th>Counts towards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Courses</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Select a minimum of two courses of the following:</td>
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<td>6</td>
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</tr>
<tr>
<td>CE 536</td>
<td>Introduction to Numerical Methods for Civil Engineers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE 537</td>
<td>Computer Methods and Applications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE 591</td>
<td>Special Topics in Civil Engineering Computing</td>
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<tr>
<td>CE 737</td>
<td>Computer-Aided Engineering Systems</td>
<td></td>
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</tr>
<tr>
<td>CE 791</td>
<td>Advanced Topics in Civil Engineering Computing (High performance computer modeling)</td>
<td></td>
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</tr>
<tr>
<td>CE 791</td>
<td>Advanced Topics in Civil Engineering Computing (Evolutionary computation)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE 791</td>
<td>Advanced Topics in Civil Engineering Computing (Inverse modeling)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE 791</td>
<td>Advanced Topics in Civil Engineering Computing (Advanced methods for systems analysis)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE 7XX</td>
<td>Complex adaptive systems analysis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Electives

1. Select at least one course in the following:

   - CE 724 | Probabilistic Methods Of Structural Engineering | 3 |
   - CE 721 | Matrix and Finite Element Structural Analysis | 3 |
   - CE 7XX | Complex adaptive systems analysis | |

2. Select at least one course in the following:

   - ISE 501 | Introduction to Operations Research | 3 |
   - MA/ISE 505 | Linear Programming | 3 |
   - ISE 708 | Integer Programming | 3 |
   - ISE 709 | Dynamic Programming | 3 |
   - ISE 712 | Bayesian Decision Analysis For Engineers and Managers | 3 |
   - MA 501 | Advanced Mathematics for Engineers and Scientists I | 3 |
   - MA 502 | Advanced Mathematics for Engineers and Scientists II | 3 |
   - MA/CSC 580 | | 3 |
   - MA/CSC 583 | Introduction to Parallel Computing | 3 |
   - MA 584 | Numerical Solution of Partial Differential Equations--Finite Difference Methods | 3 |
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>MA 587</td>
<td>Numerical Solution of Partial Differential Equations--Finite Element Method</td>
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<tr>
<td>MA/ST 706</td>
<td>Nonlinear Programming</td>
<td>3</td>
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<tr>
<td>CSC 501</td>
<td>Operating Systems Principles</td>
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</tr>
<tr>
<td>CSC 548</td>
<td>Parallel Systems</td>
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</table>

**Total Hours** 66-69

1. Other relevant departmental courses
2. Other recommended courses

### Construction Engineering Specialization

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>CON XXX</td>
<td>Select a minimum of seven courses</td>
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<table>
<thead>
<tr>
<th>Code</th>
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<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>CE 536</td>
<td>Introduction to Numerical Methods for Civil Engineers</td>
<td></td>
</tr>
<tr>
<td>CE 537</td>
<td>Computer Methods and Applications</td>
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<tr>
<td>CE 538</td>
<td>Information Technology and Modeling</td>
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</tr>
<tr>
<td>CE 592</td>
<td>Special Topics in Construction Engineering</td>
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</tr>
<tr>
<td>CE 522</td>
<td>Theory and Design Of Prestressed Concrete</td>
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</tr>
<tr>
<td>CE 523</td>
<td>Theory and Behavior Of Steel Structures</td>
<td></td>
</tr>
<tr>
<td>CE 524</td>
<td>Analysis and Design Of Masonry Structures</td>
<td></td>
</tr>
<tr>
<td>CE 528</td>
<td>Structural Design in Wood</td>
<td></td>
</tr>
<tr>
<td>CE 548</td>
<td>Engineering Properties Of Soils I</td>
<td></td>
</tr>
<tr>
<td>CE 549</td>
<td>Soil and Site Improvement</td>
<td></td>
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</tbody>
</table>

**Total Hours** 33

### Environmental, Water Resources, and Coastal Engineering Specialization

- 30 graduate-level credit hours

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>CE 607</td>
<td>Water Resource and Environmental Engineering Seminar</td>
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<tr>
<td>CE 695</td>
<td>Master's Thesis Research</td>
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</table>

**Total Hours** 2-7

### Geotechnical and Geoenvironmental Engineering Specialization

- 30 graduate-level credit hours

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 695</td>
<td>Master's Thesis Research</td>
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</table>

**Total Hours** 6
# Mechanics and Materials Specialization

- 30 graduate-level credit hours

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
<th>Counts towards</th>
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<tbody>
<tr>
<td>CE 695</td>
<td>Master's Thesis Research</td>
<td>1-6</td>
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</tbody>
</table>

Total Hours: 1-6

### Structural Engineering and Mechanics Specialization

<table>
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<th>Title</th>
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<tbody>
<tr>
<td>CE 515</td>
<td>Advanced Strength of Materials</td>
<td>3</td>
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<tr>
<td>CE 526</td>
<td>Finite Element Method in Structural Engineering</td>
<td>3</td>
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<tr>
<td>CE 527</td>
<td>Structural Dynamics</td>
<td>3</td>
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<tr>
<td></td>
<td>Select one of the following SEM Behavior and Design courses:</td>
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<tr>
<td>CE 522</td>
<td>Theory and Design Of Prestressed Concrete</td>
<td>3</td>
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<tr>
<td>CE 523</td>
<td>Theory and Behavior Of Steel Structures</td>
<td>3</td>
<td></td>
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<tr>
<td>CE 524</td>
<td>Analysis and Design Of Masonry Structures</td>
<td>3</td>
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<tr>
<td>CE 528</td>
<td>Structural Design in Wood</td>
<td>3</td>
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<tr>
<td>CE 529</td>
<td>FRP Strengthening and Repair of Concrete Structures</td>
<td>3</td>
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<tr>
<td>CE 726</td>
<td>Advanced Theory Of Concrete Structures</td>
<td>3</td>
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<tr>
<td>CE 794</td>
<td>Advanced Topics in Structures and Mechanics</td>
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<td>Select two of the following additional SEM courses:</td>
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<tr>
<td>CE 525</td>
<td>Advanced Structural Analysis</td>
<td>3</td>
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<tr>
<td>CE 721</td>
<td>Matrix and Finite Element Structural Analysis</td>
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Total Hours: 19-24

### Electives

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</thead>
<tbody>
<tr>
<td>CE 695</td>
<td>Master's Thesis Research</td>
<td>1-6</td>
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</table>

**CE 530** Properties of Concrete and Advanced Cement-Based Composites

**CE 714** Stress Waves

**CE 718** Constitutive Modeling of Engineering Materials

**CE 730** Mechanics and Failure of Quasi-Brittle Materials

**CE 723** Advanced Structural Dynamics

**CE 724** Probabilistic Methods Of Structural Engineering

**CE 725** Earthquake Structural Engineering

**CE 722** Theory and Design Of Prestressed Concrete

**CE 523** Theory and Behavior Of Steel Structures

**CE 524** Analysis and Design Of Masonry Structures

**CE 528** Structural Design in Wood

**CE 529** FRP Strengthening and Repair of Concrete Structures

**CE 726** Advanced Theory Of Concrete Structures

**CE 794** Advanced Topics in Structures and Mechanics

**Electives**

<table>
<thead>
<tr>
<th>Code</th>
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<th>Counts towards</th>
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<tbody>
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<td>CE 525</td>
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<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
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<tr>
<td>CE 721</td>
<td>Matrix and Finite Element Structural Analysis</td>
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<td>CE 530</td>
<td>Properties of Concrete and Advanced Cement-Based Composites</td>
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<td>CE 714</td>
<td>Stress Waves</td>
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<tr>
<td>CE 718</td>
<td>Constitutive Modeling of Engineering Materials</td>
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<td>CE 730</td>
<td>Mechanics and Failure of Quasi-Brittle Materials</td>
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<td>CE 723</td>
<td>Advanced Structural Dynamics</td>
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<td>CE 724</td>
<td>Probabilistic Methods Of Structural Engineering</td>
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<td>Earthquake Structural Engineering</td>
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<td>Theory and Design Of Prestressed Concrete</td>
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<td>CE 529</td>
<td>FRP Strengthening and Repair of Concrete Structures</td>
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<td>CE 726</td>
<td>Advanced Theory Of Concrete Structures</td>
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<td>CE 794</td>
<td>Advanced Topics in Structures and Mechanics</td>
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<td>CE 537</td>
<td>Computer Methods and Applications</td>
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<tr>
<td>CE 591</td>
<td>Special Topics in Civil Engineering Computing</td>
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<td>CE 737</td>
<td>Computer-Aided Engineering Systems</td>
<td>3</td>
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</tr>
<tr>
<td>CE 791</td>
<td>Advanced Topics in Civil Engineering Computing (High Performance Computing)</td>
<td>1-3</td>
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<tr>
<td>CE 548</td>
<td>Engineering Properties Of Soils I</td>
<td>3</td>
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<tr>
<td>CE 593</td>
<td>Special Topics in Geotechnical Engineering (Unsaturated Soil Mechanics)</td>
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<td>CE 593</td>
<td>Special Topics in Geotechnical Engineering (Site Response Analysis)</td>
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<td>CE 741</td>
<td>Geomechanics of Stress Deformation</td>
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<td>CE 742</td>
<td>Deformation and Instability of Soils</td>
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<td>CE 744</td>
<td>Foundation Engineering</td>
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<td>CE 746</td>
<td>Soil Dynamics and Earthquake Engineering</td>
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<td>CE 747</td>
<td>Geosynthetics in Geotechnical Engineering</td>
<td>3</td>
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<tr>
<td>CE 596</td>
<td>Special Topics in Water Resource and Environmental Engineering (Measurement and Data Analysis)</td>
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<tr>
<td>CE 594</td>
<td>Special Topics in Structures and Mechanics (Nondestructive Evaluation of Civil Infrastructure)</td>
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<td>CE 594</td>
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<td>CE 759</td>
<td>Inelastic Behavior Of Construction Materials</td>
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<tr>
<td>MA 405</td>
<td>Introduction to Linear Algebra</td>
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</table>
MA 501  Advanced Mathematics for Engineers and Scientists I  3

MA 502  Advanced Mathematics for Engineers and Scientists II  3

CE 675  Civil Engineering Projects (Independent Study)  1-3

### Transportation Materials and Systems Specialization

- 30-31 graduate credit hours
- 24/30 credits at 500-level or higher

<table>
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<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>CE 501</td>
<td>Transportation Systems Engineering</td>
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<td>CE 502</td>
<td>Traffic Operations</td>
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<td>CE 503</td>
<td>Highway Design</td>
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<td>CE 504</td>
<td>Airport Planning and Design</td>
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<tr>
<td>CE 506</td>
<td>Transportation Engineering Data Collection and Analysis</td>
<td>3</td>
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<tr>
<td>CE 509</td>
<td>Highway Safety</td>
<td>3</td>
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<tr>
<td>CE 594</td>
<td>Special Topics in Structures and Mechanics (Nondestructive Testing)</td>
<td>1-6</td>
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<tr>
<td>CE 595</td>
<td>Special Topics in Transportation Engineering (Asphalt/Bituminous Materials)</td>
<td>1-6</td>
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</tr>
</tbody>
</table>

### Thesis Research

Select up to six credit hours  1-6

### Accelerated Bachelor's/Master's Degree Requirements

The Accelerated Bachelors/Master’s (ABM) degree program allows exceptional undergraduate students at NC State an opportunity to complete the requirements for both the Bachelor’s and Master’s degrees at an accelerated pace. These undergraduate students may double count up to 12 credits and obtain a non-thesis Master’s degree in the same field within 12 months of completing the Bachelor’s degree, or obtain a thesis-based Master’s degree in the same field within 18 months of completing the Bachelor’s degree.

This degree program also provides an opportunity for the Directors of Graduate Programs (DGPs) at NC State to recruit rising juniors in their major to their graduate programs. However, permission to pursue an ABM degree program does not guarantee admission to the Graduate School. Admission is contingent on meeting eligibility requirements at the time of entering the graduate program.


CCEE Department ABM Admission

The CCEE department encourages excellent undergraduate students to obtain a master’s degree in their chosen field of specialization within 2 to 3 semesters past BS graduation, through double counting up to 9 credit hours towards both bachelor’s and master’s degrees. This is referred to as the Accelerated Bachelor’s/Master’s (ABM) degree program. Following is the pathway for the ABM program.

Step 1 – Verify your eligibility for applying to the ABM program

- You must have completed at least 75 credit hours (this typically means junior standing)
  - If you are a transfer student, you must have completed at least two semesters at NCSU, earning a minimum of 24 credit hours
- You must not have already received a BS degree
- You must have an overall GPA ≥ 3.5 and major GPA ≥ 3.25

Step 2 – Apply for ABM by following the steps below

- Determine your area of interest from the list of graduate specialty areas on the next page.
- Talk to the ABM advisor in the specialty area (provided below), and agree on a tentative ABM Plan of Work (POW) that would suit your interests and satisfy the ABM requirements. A finalized ABM POW must be in place before completion of the BS degree.
- Submit an application at go.ncsu.edu/ccee-abm (https://applygrad.ncsu.edu/register/?id=4d63529c-6ad8-4680-9655-e4e49554ac56), which includes the tentative ABM POW.
  - The application will first be reviewed by the ABM advisor and a recommendation will be made to the department. The final determination will be made after a joint review by the directors of undergraduate and graduate programs, after which you will be notified.

Step 3 – While in the ABM program, maintain status by following the steps below:

- With the specialty area ABM advisor’s help, prepare a tentative Graduate POW, that complements the Undergraduate POW.
  - Up to 9 credit hours can be double counted, they must be at the 500 level, and they must be selected from the approved list of courses in the specialty area (provided in the subsequent pages).
  - The (tentative) Graduate POW must be formally approved by the ABM advisor.
  - It is your responsibility to ensure that both the Graduate POW and Undergraduate POW satisfy the respective master’s and undergraduate degree requirements
  - You must maintain an overall GPA ≥ 3.5 and a major GPA ≥ 3.25 until you enter the master’s program.
  - Only graduate courses with a grade # B can be double counted. Courses with a grade # B- cannot be counted towards the master’s degree.
  - Towards the end of your bachelor’s program, you must formally apply to the master’s program, per deadlines published by the graduate school. Note that the GRE may be waived for ABM students – consult with your ABM advisor. The application must include to include a completed and signed ABM Plan of Work (https://grad.ncsu.edu/wp-content/uploads/2015/11/abm-plan-of-work.pdf).
- You must complete the master’s degree within a time limit (12 months if MCE/MENE, 18 months if MSCE/MSENE), to take advantage of the double counting associated with the ABM. If you do not graduate within this time, you will be considered a regular master’s student needing to take the full 30/31 graduate credits solely towards your master’s degree.

Graduate Specialty Areas for ABM

Degrees earned will be distributed as: “Master of Civil Engineering” without specialization specifications.

- Computing and Systems
- Construction Engineering
- EWC – Air
- EWC – Environmental Process Engineering
- EWC – Water Resource and Coastal Engineering
- Geotechnical Engineering
- Structural Engineering and Mechanics
- Transportation Materials
- Transportation Systems

Allowable Courses by Specialty Area

<table>
<thead>
<tr>
<th>COMPLETING SYSTEMS</th>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>CE 536</td>
<td>Introduction to Numerical Methods for Civil Engineers</td>
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<tr>
<td>CE 537</td>
<td>Computer Methods and Applications</td>
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<td>CE 538</td>
<td>Information Technology and Modeling</td>
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<tr>
<td>CE 590</td>
<td>Special Topics In Civil Engineering (Civil Engineering Systems)</td>
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<table>
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<tr>
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<td>CE 561</td>
<td>Construction Project Management</td>
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<tr>
<td>CE 562</td>
<td>Lean Construction Concepts and Methods</td>
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<tr>
<td>CE 564</td>
<td>Legal Aspects of Contracting</td>
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<tr>
<td>CE 565</td>
<td>Construction Safety Management</td>
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<td>CE 567</td>
<td>Risk and Financial Management in Construction</td>
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</table>
Other courses may selected and approved in conjunction with the academic committee, examples include but are not subject to:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
<th>Counts towards</th>
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<tbody>
<tr>
<td>CE 515</td>
<td>Advanced Strength of Materials</td>
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<td>CE 522</td>
<td>Theory and Design Of Prestressed Concrete</td>
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<td>Analysis and Design Of Masonry Structures</td>
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<tr>
<td>CE 548</td>
<td>Engineering Properties Of Soils I</td>
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**EWC – AIR**

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<tr>
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<tbody>
<tr>
<td>CE 576</td>
<td>Engineering Principles Of Air Pollution Control *</td>
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<tr>
<td>CE 578</td>
<td>Energy and Climate</td>
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<tr>
<td>CE 579</td>
<td>Principles of Air Quality Engineering</td>
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**EWC – ENVIRONMENTAL PROCESS ENGINEERING**

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<tbody>
<tr>
<td>CE 571</td>
<td>Physical Principles of Environmental Engineering</td>
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<td>CE 573</td>
<td>Biological Principles of Environmental Engineering</td>
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<td>CE 574</td>
<td>Chemical Principles of Environmental Engineering</td>
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<tr>
<td>CE 577</td>
<td>Engineering Principles Of Solid Waste Management *</td>
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<tr>
<td>CE 578</td>
<td>Energy and Climate</td>
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**EWC – WATER RESOURCES, COASTAL**

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<tbody>
<tr>
<td>CE 581</td>
<td>Fluid Mechanics in Natural Environments</td>
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<tr>
<td>CE 583</td>
<td>Engineering Aspects Of Coastal Processes</td>
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<tr>
<td>CE 584</td>
<td>Hydraulics Of Ground Water</td>
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<tr>
<td>CE 586</td>
<td>Engineering Hydrology</td>
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<td>CE 588</td>
<td>Water Resources Engineering</td>
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<tr>
<td>CE 596</td>
<td>Special Topics in Water Resource and Environmental Engineering (Coastal Hydrodynamics) *</td>
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<tr>
<td>CE 596</td>
<td>Special Topics in Water Resource and Environmental Engineering (Coastal Modeling)</td>
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<tr>
<td>CE 596</td>
<td>Special Topics in Water Resource and Environmental Engineering (Surface Water Quality Modeling)</td>
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**GEOTECHNICAL ENGINEERING**

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<tbody>
<tr>
<td>CE 548</td>
<td>Engineering Properties Of Soils I</td>
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<tr>
<td>CE 584</td>
<td>Hydraulics Of Ground Water</td>
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<tr>
<td>CE 593</td>
<td>Special Topics in Geotechnical Engineering (Dynamics of Soils and Foundations)</td>
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</table>
Other courses may selected and approved in conjunction with the academic committee, examples include but are not subject to:

<table>
<thead>
<tr>
<th>Code</th>
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<tbody>
<tr>
<td>CE 515</td>
<td>Advanced Strength of Materials</td>
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<tr>
<td>CE 526</td>
<td>Finite Element Method in Structural Engineering</td>
</tr>
<tr>
<td>CE 577</td>
<td>Engineering Principles Of Solid Waste Management</td>
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### STRUCTURAL ENGINEERING AND MECHANICS

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<tbody>
<tr>
<td>CE 515</td>
<td>Advanced Strength of Materials</td>
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<tr>
<td>CE 522</td>
<td>Theory and Design Of Prestressed Concrete</td>
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<tr>
<td>CE 523</td>
<td>Theory and Behavior Of Steel Structures</td>
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<td>CE 524</td>
<td>Analysis and Design Of Masonry Structures</td>
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<tr>
<td>CE 525</td>
<td>Advanced Structural Analysis</td>
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<td>CE 526</td>
<td>Finite Element Method in Structural Engineering</td>
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<tr>
<td>CE 527</td>
<td>Structural Dynamics</td>
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<td>CE 528</td>
<td>Structural Design in Wood</td>
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<td>CE 529</td>
<td>FRP Strengthening and Repair of Concrete Structures</td>
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<tr>
<td>CE 530</td>
<td>Properties of Concrete and Advanced Cement-Based Composites</td>
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### TRANSPORTATION MATERIALS

<table>
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<tr>
<th>Code</th>
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<tbody>
<tr>
<td>CE 515</td>
<td>Advanced Strength of Materials</td>
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<td>Properties of Concrete and Advanced Cement-Based Composites</td>
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<tr>
<td>CE 548</td>
<td>Engineering Properties Of Soils I</td>
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<tr>
<td>CE 595</td>
<td>Special Topics in Transportation Engineering (A - Asphalt and Bituminous Materials)</td>
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### TRANSPORTATION SYSTEMS

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<tbody>
<tr>
<td>CE 501</td>
<td>Transportation Systems Engineering</td>
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<tr>
<td>CE 502</td>
<td>Traffic Operations</td>
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<tr>
<td>CE 503</td>
<td>Highway Design</td>
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<tr>
<td>CE 504</td>
<td>Airport Planning and Design</td>
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<tr>
<td>CE 505</td>
<td>Railroad System Planning, Design, and Operation</td>
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<tr>
<td>CE 509</td>
<td>Highway Safety</td>
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* This course is not a prerequisite but recommended to be completed prior to enrollment.

### Faculty

#### Associate Professors

Ghadir Haikal

#### Full Professors

Jacqueline MacDonald Gibson