Civil, Construction and Environmental Engineering

The Civil, Construction, and Environmental Engineering (CCEE) department offers both a master and doctoral level program, and cutting-edge research covering various facets of Civil Engineering theory and practice. A knowledgeable and experienced group of faculty members work closely with students to provide them with the tools required to succeed professionally in globally-competitive work environments.

CE Specialty Certificate Programs

Category A certificates are offered by the Civil, Construction, and Environmental Engineering Department. Any undergraduate or graduate student in good standing who is pursuing a Civil Engineering degree (BSCE, MSCE, PhD) may elect to simultaneously complete the requirements of his or her degree program and the Certificate Program. These certificates are listed on student transcripts and in the university graduation bulletin. Certificates can be earned in:

1. Structural Engineering
2. Environmental Engineering
3. Transportation Engineering
4. Sustainable Engineering
5. Construction Engineering Management
6. Geotechnical Engineering

Civil Engineering (BSCE) graduates who complete the Certificate Program will have greater depth in a specific technical area. The certificates also allow a means for practicing engineers to acquire expertise beyond a Bachelor’s degree, and have it formally recognized without completing a program leading to a Master’s degree. This technical expertise will enhance their proficiency and marketability. Up to 12 graduate level credit hours taken for a certificate may be applied toward the MSCE degree.

Students who wish to pursue a CE Certificate must be admitted to the Department as either undergraduate or graduate students (BSCE or MSCE program). Students who are not currently enrolled in the civil engineering program may be admitted as a non-degree seeking student to earn a Certificate.

Certificates require a minimum of 15 semester hours. They consist of one required course (which may also count toward the BSCE degree at UAB) and four graduate level elective courses in the area of specialization. Courses that can be applied towards the Certificate can be found at http://www.uab.edu/engineering/home/departments-research/civil

For more information, please contact Dr. Fouad Fouad, Department Chair, 140 Hoehn Engineering Building, 1075 13th Street South, telephone (205) 934-8430, e-mail ffouad@uab.edu

The following three concentrations in the online Master in Engineering program are offered through the Department of Civil, Construction, and Environmental Engineering:

- Construction Engineering Management
- Structural Engineering
- Sustainable Smart Cities

Special Topics (590/690/790) courses and Independent Study (591/691/791) courses are reviewed for degree applicability for each program in the School of Engineering. No more than 6 combined hours of Special Topics and/or Independent Study courses will be applied to the MSBME without appeal to and approval from the Program Director.

The School of Engineering offers similar courses at the 400/500 and 600/700 levels. While the higher numbered course has more advanced content, there is a significant overlap in topics. Therefore, students are not allowed to take a 500-level or 700-level course for credit if they have previously taken the related 400-level or 600 level course, respectively.

Construction Engineering Management Concentration

Please Note: All Master of Engineering concentrations are totally online. There are no campus classes or required on-campus meetings or activities. Course delivery includes asynchronous and synchronous learning modes.

<table>
<thead>
<tr>
<th>Degree Offered</th>
<th>Master of Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Website</td>
<td><a href="http://www.uab.edu/engineering/cem">http://www.uab.edu/engineering/cem</a></td>
</tr>
<tr>
<td>Director</td>
<td>Wesley Zech, PhD, LEED AP</td>
</tr>
<tr>
<td>Email</td>
<td><a href="mailto:zechwes@uab.edu">zechwes@uab.edu</a></td>
</tr>
<tr>
<td>Assistant Director</td>
<td>Dianne Gilmer, MEng</td>
</tr>
<tr>
<td>Email</td>
<td><a href="mailto:digilmer@uab.edu">digilmer@uab.edu</a></td>
</tr>
<tr>
<td>Phone</td>
<td>205-975-5848</td>
</tr>
<tr>
<td>Address</td>
<td>UAB School of Engineering, HOEN 130B</td>
</tr>
<tr>
<td></td>
<td>1720 2nd Avenue South, Birmingham, AL 35294-4440</td>
</tr>
</tbody>
</table>

The Master of Engineering with a concentration in Construction Engineering Management (MEng-CEM) is designed to enhance the engineering and business qualifications of working professionals interested in project and company management.

Admission Requirements

In addition to the Graduate School admission requirements, admission to the UAB MEng-CEM includes the following:

1. Bachelor’s degree from a regionally accredited US college or university
2. Personal interview with the Assistant Director (schedule the interview prior to submitting an application)
3. Three letters of recommendation from professional contacts which speak to your character, work ethic, and why the writer believes you will succeed in graduate school
4. Personal essay detailing motivation and career aspirations for earning the degree
5. Resume/Curriculum Vitae
6. NO GRE REQUIRED
7. For applicants whose first language is not English, TOEFL score of 80 (with a minimum score of 18 on each subsection) or higher OR IELTS score of 6.5 or higher (Institution code – 1856, applicable to TOEFL only)
To apply: Visit the UAB Graduate School website (uab.edu/graduate) and click the 'Apply Now' button. Choose Construction Engineering Management in the Program Applying To section. Under Additional Information, you will be asked to upload additional documentation.

### Pre-Defined Table

<table>
<thead>
<tr>
<th>Deadline for Entry Term(s)</th>
<th>Fall: August 1; Spring: December 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deadline for All Application Materials to be in the Graduate School Office</td>
<td>Six weeks before term begins (see UAB academic calendar - <a href="https://www.uab.edu/students/academics/academic-calendar">https://www.uab.edu/students/academics/academic-calendar</a>)</td>
</tr>
</tbody>
</table>

### Master of Engineering with a concentration in Construction Engineering Management

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CECM 669 Advanced Project Management</td>
<td>3</td>
</tr>
<tr>
<td>CECM 670 Construction Estimating and Bidding</td>
<td>3</td>
</tr>
<tr>
<td>CECM 671 Construction Liability &amp; Contracts</td>
<td>3</td>
</tr>
<tr>
<td>CECM 672 Construction Methods and Equipment</td>
<td>3</td>
</tr>
<tr>
<td>CECM 673 Project Planning and Control</td>
<td>3</td>
</tr>
<tr>
<td>CECM 674 Green Building Design/Construction</td>
<td>3</td>
</tr>
<tr>
<td>CECM 675 Advanced Construction and Engineering Economics</td>
<td>3</td>
</tr>
<tr>
<td>CECM 676 Construction Project Risk Management</td>
<td>3</td>
</tr>
<tr>
<td>CECM 688 Construction Management and Leadership Challenges in the Global Environment</td>
<td>3</td>
</tr>
<tr>
<td>CECM 689 Building Information Modeling (BIM) Techniques</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Hours</strong></td>
<td><strong>30</strong></td>
</tr>
</tbody>
</table>

### Sustainable Smart Cities Concentration

Please Note: All Master of Engineering concentrations are totally online. There are no campus classes or required on-campus meetings or activities. Course delivery includes asynchronous and synchronous learning modes.

<table>
<thead>
<tr>
<th>Degree Offered</th>
<th>Master of Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Website</td>
<td><a href="http://www.uab.edu/engineering/">http://www.uab.edu/engineering/</a></td>
</tr>
<tr>
<td>Director</td>
<td>Jason T. Kirby, PhD</td>
</tr>
<tr>
<td>E-mail</td>
<td><a href="mailto:jtkirby@uab.edu">jtkirby@uab.edu</a></td>
</tr>
<tr>
<td>Phone</td>
<td>205-934-8479</td>
</tr>
<tr>
<td>Address</td>
<td>UAB School of Engineering, HOEN 340, 1720 2nd Avenue South, Birmingham, AL 35294-4440</td>
</tr>
</tbody>
</table>

### Admission Requirements

In addition to the Graduate School admission requirements, requirements for admission to the UAB MEng-SSC program include the following:

1. A Bachelor's degree (or equivalent) from a recognized institution of higher education in an appropriate subject/related science including but not limited to: Urban Design and Planning, Political Science, Geography, Environmental Science, Environmental Management, Public Health, Social Sciences, Criminal Justice, Information and Communication Technology, and/or Engineering.

2. Candidates who have related employment or substantial industrial experience, with a demonstrable interest in or a commitment to urban planning, sustainability and environmental management issues, and/or smart city approaches will also be considered.

3. All program students will be required to register / enroll at both UAB and Staffordshire University (SU). Details on the Graduate application packet are available online.

4. For applicants whose first language is not English, TOEFL score of 80 (with a minimum score of 18 on each subsection) or higher OR IELTS score of 6.5 or higher (Institution code – 1856, applicable to TOEFL only)

### Structural Engineering Concentration

Please Note: All Master of Engineering concentrations are totally online. There are no campus classes or required on-campus meetings or activities. Course delivery includes asynchronous and synchronous learning modes.

<table>
<thead>
<tr>
<th>Degree Offered</th>
<th>Master of Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Website</td>
<td><a href="http://www.uab.edu/engineering/">http://www.uab.edu/engineering/</a></td>
</tr>
<tr>
<td>Director</td>
<td>Christopher Waldron, PhD, PE</td>
</tr>
<tr>
<td>E-mail</td>
<td><a href="mailto:cwaldron@uab.edu">cwaldron@uab.edu</a></td>
</tr>
<tr>
<td>Phone</td>
<td>205-934-8435</td>
</tr>
<tr>
<td>Address</td>
<td>UAB School of Engineering, HOEN 130B, 1720 2nd Avenue South, Birmingham, AL 35294-4440</td>
</tr>
</tbody>
</table>

The Master of Engineering with a concentration in Structural Engineering is designed to increase the technical knowledge of engineering professionals working in, or desiring to work in, the broad field of structural engineering.

### Admission Requirements

In addition to the Graduate School admission requirements, requirements for admission to the UAB MEng-STR program include the following:

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CESC 600 Principles of Sustainable Development</td>
<td>3</td>
</tr>
<tr>
<td>CESC 602 Introduction to Sustainable Smart Cities</td>
<td>3</td>
</tr>
<tr>
<td>CESC 604 Low-Carbon and Renewable Energy Systems for Smart Cities</td>
<td>3</td>
</tr>
<tr>
<td>CESC 606 Managing Natural Resources and Sustainable Smart Cities</td>
<td>3</td>
</tr>
<tr>
<td>CESC 608 Green Infrastructure and Transportation</td>
<td>3</td>
</tr>
<tr>
<td>CESC 610 Health and Liveability</td>
<td>3</td>
</tr>
<tr>
<td>CESC 612 Green Buildings</td>
<td>3</td>
</tr>
<tr>
<td>CESC 614 Smart Cities Technologies</td>
<td>3</td>
</tr>
<tr>
<td>CESC 616 Big Data and Smart Cities</td>
<td>3</td>
</tr>
<tr>
<td>CESC 618 Research Methods and Project Planning</td>
<td>3</td>
</tr>
<tr>
<td>CESC 620 Sustainable Smart Cities Research Project</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total Hours</strong></td>
<td><strong>30</strong></td>
</tr>
</tbody>
</table>
1. A civil or mechanical engineering bachelor's degree from an ABET accredited U.S. college or university or a bachelor’s degree in a closely related science
2. An undergraduate GPA of 3.0 or higher (individuals not meeting this requirement may be admitted with a strong professional background, strong references, and a strong interview)
3. Three letters of recommendation from professional contacts
4. Personal essay detailing motivation for earning the degree
5. Resume/CV
6. An interview with the program director
7. No GRE required
8. For applicants whose first language is not English, TOEFL score of 80 (with a minimum score of 18 on each subsection) or higher OR IELTS score of 6.5 or higher (Institution code – 1856, applicable to TOEFL only)

Deadline for All Application Materials to be in the Graduate School Office Six weeks before term begins (see UAB academic calendar - https://www.uab.edu/students/academic-calendar)
Application Submission Deadline for Entry Term(s) Fall: August 1; Spring: December 1; Summer: May 1

Requirements Hours
Required Courses 24
CESE 656 Advanced Mechanics of Materials for Structural Engineering
CESE 657 Advanced Design of Steel Structures
CESE 659 Advanced Reinforced Concrete
CESE 660 Prestressed Concrete Behavior and Design
CESE 662 Advanced Structural Analysis
CESE 664 Bridge Engineering
CESE 676 Design of Structural Steel Connections
Electives (choose 2) 6
CECM 669 Advanced Project Management
CECM 671 Construction Liability & Contracts
CECM 673 Project Planning and Control
CECM 674 Green Building Design/Construction
CECM 675 Advanced Construction and Engineering Economics
CECM 676 Construction Project Risk Management
CECM 689 Building Information Modeling (BIM) Techniques

Total Hours 30

Curriculum

Requirements Hours
Students must complete a minimum of 30 hours with the classes listed below 30
All CESE courses at the 600 level
All CECM courses with advisor-approval 600-791 (maximum of 9 hours)
All CE courses with advisor-approval 500-791 (maximum of 12 hours)

Total Hours 30

Admission Requirements

In addition to the UAB Graduate School admission requirements, requirements for admission to the program leading to the Master of Science in Civil Engineering degree include the following five criteria:

1. An undergraduate engineering degree from an ABET accredited engineering program or applied science program. Applicants who have an outstanding academic record in an unaccredited engineering or applied science degree program may be admitted at program discretion. Students admitted from this category may be required to complete a sequence of undergraduate courses in addition to the normal requirements of the MSCE degree. This set of extra requirements will be specified in writing at the time of admission to the program.
2. GPA of 3.0 or better on a 4.0 scale in all undergraduate degree major courses attempted;
3. Three letters of evaluation concerning the applicant’s previous academic and professional work; and
4. Scores on the GRE General Test are not required (but are accepted) for applicants who receive a BS degree from a program accredited by the Engineering Accreditation Committee of ABET (http://www.abet.org), or from other programs with reciprocal agreement under the Washington Accord (http://www.ieagreements.org/agreements/washington/). The GRE General Test is required for all other applicants.
5. In addition, a minimum score of 80 on the TOEFL or a 6.5 on the IELTS is required for international applicants whose native language is not English.
6. Verification of registration by examination as a Professional Engineer (PE) will satisfy criteria 4 above.

Program Requirements

The following minimum requirements apply to the plan of study for a student who has earned a baccalaureate degree in civil engineering. A student with an undergraduate degree in another field may also be accepted into the civil engineering program but will normally have to take additional preparatory coursework as part of an expanded plan of study. Continuous enrollment for at least 3 credit hours per term is required. Students receiving a research assistantship are required to be enrolled as full-time students every semester. A full-time student is one who is enrolled in at least 9 credit hours per semester. Enrollment in the Civil Engineering Graduate Seminar (CE 641) is required at least once prior to graduation.

Special Topics (590/690/790) courses and Independent Study (591/691/791) courses are reviewed for degree applicability for each program in the School of Engineering. No more than 6 combined hours of Special Topics and/or Independent Study courses will be applied to the MSCE without appeal to and approval from the Program Director.

Special Topics (590/690/790) courses and Independent Study (591/691/791) courses are reviewed for degree applicability for each program in the School of Engineering. No more than 6 combined hours of Special Topics and/or Independent Study courses will be applied to the MSBME without appeal to and approval from the Program Director.

The School of Engineering offers similar courses at the 400/500 and 600/700 levels. While the higher numbered course has more advanced content, there is a significant overlap in topics. Therefore, students are not allowed to take a 500-level or 700-level course for credit if they have previously taken the related 400-level or 600 level course, respectively.
Master of Science in Civil Engineering

Plan I (Thesis Option)
1. In addition to the general Graduate School requirements, the student must successfully complete at least 33 semester hours of graduate credit, including:
   a) A minimum of 18 semester hours in civil engineering;
   b) Up to 6 semester hours in disciplines outside civil engineering, such as other engineering disciplines, mathematics, biology, earth science, physics, urban affairs, or public health.
   c) A minimum of 9 hours of CE 699-Masters Thesis Research.

2. All Plan I Master’s students are required to complete online modules covering the 9 topic areas of RCR research integrity. The modules can be accessed online at https://www.citiprogram.org.

Plan II (Non-Thesis Option):
The student must successfully complete at least 33 semester hours of graduate credit including:

- A minimum of 24 semester hours in civil engineering;
- Up to 6 semester hours in disciplines outside civil engineering, such as: other engineering disciplines, mathematics, biology, earth sciences, physics, chemistry, or public health; and
- A minimum of 3 hours of CE 698 – Non-Thesis Research under the direction of the graduate study committee chair, resulting in a committee approved written report.

Areas of Specialization
The department offers specialization programs in the fields of structural engineering/structural mechanics, environmental engineering, transportation engineering, and construction engineering management. Supporting courses are offered in geological engineering, optimization, engineering law and other areas. If a student chooses to declare a concentration, the student must choose from the courses listed below the appropriate concentration to fulfill the required 18 hours (Plan 1) or 24 hours (Plan 2) within civil engineering.

Concentration in Structural Engineering

Requirements

Select 18 hours for Plan I or 24 hours for Plan II

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 516</td>
<td>Mechanical Vibrations</td>
<td>3</td>
</tr>
<tr>
<td>CE 520</td>
<td>Advanced Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>CE 526</td>
<td>Foundation Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CE 544</td>
<td>Civil Engineering Analysis II</td>
<td>3</td>
</tr>
<tr>
<td>CE 553</td>
<td>Design of Wood Structures</td>
<td>3</td>
</tr>
<tr>
<td>CE 554</td>
<td>Design of Masonry Structures</td>
<td>3</td>
</tr>
<tr>
<td>CE 556</td>
<td>Prestressed Concrete Design</td>
<td>3</td>
</tr>
<tr>
<td>CE 557</td>
<td>Concrete Technology</td>
<td>3</td>
</tr>
<tr>
<td>CE 560</td>
<td>Structural Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>CE 561</td>
<td>Introduction to the Finite Element Method</td>
<td>3</td>
</tr>
<tr>
<td>CE 562</td>
<td>Advanced Structural Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CE 564</td>
<td>Structural Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>CE 590</td>
<td>Special Topics in Civil Engineering 1</td>
<td>3</td>
</tr>
<tr>
<td>CE 612</td>
<td>Theory of Elasticity</td>
<td>3</td>
</tr>
<tr>
<td>CE 617</td>
<td>Theory of Plates and Shells</td>
<td>3</td>
</tr>
<tr>
<td>CE 641</td>
<td>Civil Engineering Seminar 2</td>
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</tr>
<tr>
<td>CE 650</td>
<td>Advanced Structural Steel</td>
<td>3</td>
</tr>
</tbody>
</table>

Concentration in Transportation Engineering

Requirements

Select 18 hours for Plan I or 24 hours for Plan II

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 543</td>
<td>Pavement Design &amp; Construction</td>
<td>3</td>
</tr>
<tr>
<td>CE 590</td>
<td>Special Topics in Civil Engineering 1</td>
<td>3</td>
</tr>
<tr>
<td>CE 621</td>
<td>Transportation Engineering Seminar</td>
<td>1</td>
</tr>
<tr>
<td>CE 622</td>
<td>Traffic Flow Theory</td>
<td>3</td>
</tr>
<tr>
<td>CE 624</td>
<td>Simulation Models for Transportation Applications</td>
<td>3</td>
</tr>
<tr>
<td>CE 625</td>
<td>Intelligent Transportation Systems</td>
<td>3</td>
</tr>
<tr>
<td>CE 646</td>
<td>Traffic Engineering Operations</td>
<td>3</td>
</tr>
<tr>
<td>CE 641</td>
<td>Civil Engineering Seminar 2</td>
<td>0</td>
</tr>
<tr>
<td>CE 648</td>
<td>Urban and Transportation Planning</td>
<td>3</td>
</tr>
<tr>
<td>CE 690</td>
<td>Special Topics in (Area) 1</td>
<td>1-3</td>
</tr>
<tr>
<td>CE 691</td>
<td>Individual Study in (Area) 1</td>
<td>1-4</td>
</tr>
</tbody>
</table>

Concentration in Environmental Engineering

Requirements

Select 18 hours for Plan I or 24 hours for Plan II

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 530</td>
<td>Water Supply/Drainage Design</td>
<td>3</td>
</tr>
<tr>
<td>CE 531</td>
<td>Energy Resources</td>
<td>3</td>
</tr>
<tr>
<td>CE 533</td>
<td>Solid and Hazardous Wastes Management</td>
<td>3</td>
</tr>
<tr>
<td>CE 534</td>
<td>Air Quality Modeling and Monitoring</td>
<td>3</td>
</tr>
<tr>
<td>CE 537</td>
<td>Environmental Experimental Design and Field Sampling</td>
<td>3</td>
</tr>
<tr>
<td>CE 580</td>
<td>Introduction to Water and Wastewater Treatment</td>
<td>3</td>
</tr>
<tr>
<td>CE 585</td>
<td>Engineering Hydrology</td>
<td>3</td>
</tr>
<tr>
<td>CE 590</td>
<td>Special Topics in Civil Engineering 1</td>
<td>3</td>
</tr>
<tr>
<td>CE 600</td>
<td>Sustainable Construction</td>
<td>3</td>
</tr>
<tr>
<td>CE 608</td>
<td>Green Building Design</td>
<td>3</td>
</tr>
<tr>
<td>CE 610</td>
<td>The Engineered Environment</td>
<td>3</td>
</tr>
<tr>
<td>CE 636</td>
<td>Stormwater Pollution Management</td>
<td>3</td>
</tr>
<tr>
<td>CE 640</td>
<td>Wastewater Treatment Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CE 641</td>
<td>Civil Engineering Seminar 2</td>
<td>0</td>
</tr>
<tr>
<td>CE 690</td>
<td>Special Topics in (Area) 1</td>
<td>1-3</td>
</tr>
<tr>
<td>CE 691</td>
<td>Individual Study in (Area) 1</td>
<td>1-4</td>
</tr>
</tbody>
</table>

- or any CE 590/690 IITS course offerings from UAH, USA, and UA campuses with Program Director approval
- requirement of the Department for all graduate students to take at least once prior to graduation

Concentration in Environmental Engineering

Requirements

Select 18 hours for Plan I or 24 hours for Plan II

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 540</td>
<td>Wastewater Treatment Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CE 541</td>
<td>Civil Engineering Seminar 2</td>
<td>0</td>
</tr>
<tr>
<td>CE 690</td>
<td>Special Topics in (Area) 1</td>
<td>1-3</td>
</tr>
<tr>
<td>CE 691</td>
<td>Individual Study in (Area) 1</td>
<td>1-4</td>
</tr>
</tbody>
</table>

- or any CE 590/690 IITS course offerings from UAH, USA, and UA campuses with Program Director approval
- requirement of the Department for all graduate students to take at least once prior to graduation

The Department offers a variety of courses due to the focus areas under the Master of Science in Civil Engineering, which makes it difficult to
Admission Requirements

In addition to the UAB Graduate School admission requirements, requirements for admission to the program leading to the Master of Science in Civil Engineering degree include the following five criteria:

1. An undergraduate engineering degree from an ABET accredited program. Applicants who do not meet this criterion but who have an outstanding academic record in an engineering degree program not accredited by ABET, or in a baccalaureate degree program in a related field, may be admitted on probation. Students admitted in this category will be required to complete a sequence of undergraduate courses in addition to the normal requirements of the MSCE degree. This set of extra requirements will be specified in writing at the time of admission to the program.

2. GPA of 3.0 or better on a 4.0 scale in all undergraduate degree major courses attempted;

3. Three letters of evaluation concerning the applicant's previous academic and professional work; and

4. The GRE general test is required for all applicants who do not have significant post baccalaureate experience. As score of 156 or higher on the on the quantitative section of the GRE is recommended for admission.

5. In addition, a minimum score of 80 on the TOEFL (minimum 18 on each subsection) or a 6.5 on the IELTS is required for international applicants whose native language is not English.

6. Verification of registration by examination as a Professional Engineer (PE) will satisfy criteria 4 above.

Program Requirements

Special Topics (590/690/790) courses and Independent Study (591/691/791) courses are reviewed for degree applicability for each program in the School of Engineering. No more than 6 combined hours of Special Topics and/or Independent Study courses will be applied to the MSBME without appeal to and approval from the Program Director.

The School of Engineering offers similar courses at the 400/500 and 600/700 levels. While the higher numbered course has more advanced content, there is a significant overlap in topics. Therefore, students are not allowed to take a 500-level or 700-level course for credit if they have previously taken the related 400-level or 600 level course, respectively.

Doctor of Philosophy in Civil Engineering

This is a joint program with the University of Alabama in Huntsville (UAH). A typical student entering the program will already have an undergraduate degree in Civil Engineering from a program accredited by the Engineering Accreditation Commission of ABET. Students with outstanding records in related fields or from a non-accredited engineering program will be considered for admission on conditional standing and must remedy deficiencies in their preparation after the start of their academic program. They may then be granted unconditional standing in the doctoral program.

The program requires 48 credit hours of coursework beyond the baccalaureate level or 24 credit hours of course work beyond the master's degree, plus a minimum of 24 credit hours of dissertation research. A maximum of 6 graduate credit hours may be taken as independent study or special topics classes.

Enrollment in the Civil Engineering Graduate Seminar (CE 741) at least once prior to graduation is required. A minimum of 6 credit hours must be taken from the UAH campus and may be taken through the Intercampus Interactive Telecommunications (IITS) System here at UAB, Distance Learning courses from UAH (DL) or Web-based Instruction from UAH. Doctoral students are also required to take and pass the course GRD 717 (Responsible Conduct on Research) prior to admission to candidacy.

A dissertation committee must be set-up by the doctoral student, involving a minimum of 5 graduate faculty members; at least one faculty member must be from UAH. A comprehensive examination is required of all doctoral candidates. This examination is given after (a) all coursework is completed, and (b) the student's Graduate Committee, which consists of faculty representatives from both campuses, deems the student to have adequate preparation in the major and minor fields of study. The examination is conducted by the student's Graduate Committee and administered on the resident campus. The examination consists of a written part and an oral part. During the oral portion of the examination, the student also presents his/her dissertation proposal. The Comprehensive Examination may only be taken twice.

If the graduate student successfully passes the comprehensive exam and the dissertation proposal defense, the graduate student will then enter into doctoral candidacy. Once a doctoral candidate, the student must complete a minimum of 24 graduate hours of dissertation research (CE 799). Prior to admission of candidacy, the graduate can take research hours in the form of non-dissertation hours (CE 798); these non-dissertation research hours cannot be converted from CE 798 into CE 799).

After completing the research (a minimum of 24 hours of dissertation hours), the graduate student must develop their dissertation for review by their dissertation committee. The doctoral candidate must present an oral public defense of their dissertation. If the graduate student successfully defends their dissertation, the student then has ten working days to revise the dissertation and submit in its approved form to the Graduate School.

All required coursework must be selected from the list below.

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Hours</th>
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<tr>
<td>CE 712 Theory of Elasticity</td>
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<td>CE 715 Theory of Elastic Stability</td>
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<td>CE 717 Theory of Plates and Shells</td>
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<td>CE 721 Transportation Engineering Seminar</td>
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<td>CE 723 Non-Motorized Transportation Design and Planning</td>
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<td>CE 731 Environmental Law</td>
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<td>CE 732 Industrial Waste and Wastewater Treatment</td>
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<td>CE 736 Stormwater Pollution Management</td>
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<td>CE 738 Water and Wastewater Chemistry</td>
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<td>CE 739 Sediment Sources and Controls</td>
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<td>CE 740 Wastewater Treatment Engineering</td>
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<td>CE 749 Engineering Liability</td>
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<td>CE 750 Advanced Structural Steel</td>
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<td>CE 755 Advanced Reinforced Concrete</td>
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<td>CE 758 Engineering Management</td>
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<td>CE 763 Finite Element Methods</td>
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<td>CE 781 Environmental Chemistry</td>
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</table>
CE 782  Water Treatment Engineering  3
CE 783  Water and Wastewater Treatment Processes Lab  3
CE 786  Engineering Hydrogeology  3
CE 787  Stormwater Detention Pond Design  3
CE 790  Special Topics in (Area) 1  1-3
CE 791  Individual Studies (In Area) 1  1-4

Other Requirements
CE 741  Civil Engineering Seminar  0
GRD 717  Principles of Scientific Integrity  3
Dissertation Research 2  24
CE 799  Dissertation Research  6

PhD Students are required to complete two 3-credit hour courses offered from UAH and may be taken through IITS, at UAB, UAH Distance Learning, or web-based instruction from UAH
UAB PhD Students can also take CE 590 and CE 690 courses (see Footnote 1)

1 Must have Program Director approval prior to registration
2 Minimum of 24 hours of Dissertation Research taken over at least two semesters

CE-Civil Engineering Courses

CE 515. Building Information Modeling (BIM). 3 Hours.
This class provides an introduction to the virtual world of design and construction. Topics covered include uses for technology, what is BIM, and have a focus on AutoCAD and Revit Software. An emphasis is placed on the use of these tools and their practical applications to the real world environment. Students are provided with the software through the Autodesk Student community and are required to complete a Multi-Step term Project.

CE 516. Mechanical Vibrations. 3 Hours.
Free and forced single-degree-of-freedom systems. Multi-degree-of-freedom systems. Damped, forced two-degree-of- freedom systems. Simple continuous systems. CE 215 (Dynamics) and E 220 (Mechanics of Solids) are prerequisites for this course.

CE 520. Advanced Mechanics. 3 Hours.
Variation of stress at point including determination of principal and maximum shear stresses. Basic problems involving symmetrical deformation; thickwall cylinders, spheres, and rotating disk. Torsions of noncircular sections. Curved beams. Failure Theories. Unsymmetrical bending and shear center. CE 220 (Mechanics of Solids) is a prerequisite for this course.

CE 526. Foundation Engineering. 3 Hours.
Application of principles of soil mechanics to: determine bearing capacity and settlement of spread footings, mats, single piles and pile groups; site investigation, evaluate data from field and laboratory tests; estimation of stresses in soil masses; lateral resistance of piles and pile groups; retaining walls, sheetpiles and coffer-dams.

CE 530. Water Supply/Drainage Design. 3 Hours.
Water requirements; wastewater characteristics. Hydraulics and design of sewers; distribution, and reuse of water. Development of water supplies; design considerations. CE 337 (Hydraulics) is a prerequisite for this course.

CE 531. Energy Resources. 3 Hours.
Overview of the various energy resources: oil, natural gas, coal, nuclear, hydro, solar, geothermal, biomass, wind, and ocean energy resources, in terms of supply, distribution, recovery and conversion, environmental impacts, economies, policy, and technology. Concepts and opportunities for energy conservation; including electric power generation, changing role of electric utilities, transportation applications, and energy use in developing countries. Field trips.

CE 533. Solid and Hazardous Wastes Management. 3 Hours.
Overview of waste characterizations, regulations, and management options.

CE 534. Air Quality Modeling and Monitoring. 3 Hours.
Atmospheric pollutants; effects, reactions, and sources. Air pollution meteorology and dispersion modeling. Ambient monitoring. ME 250 (Introduction to Thermodynamic Sciences) is a prerequisite for this course.

CE 537. Environmental Experimental Design and Field Sampling. 3 Hours.
Experimental design, sensitivity analyses, water sampling, and flow monitoring. Receiving water chemical reactions. Field investigations. CE 344 (Civil Engineering Analysis I) is a prerequisite for this course.

CE 537L. Environmental Experimental Design and Field Sampling Lab. 0 Hours.
Lab experiences in environmental experimental design and field sampling.

CE 542. Hwy Materials and Construction. 3 Hours.
Properties of materials used in highway construction. Construction methods and management. CE 332 (Soil Engineering) and CE 345 (Transportation Engineering) are suggested prerequisites for this course.

CE 543. Pavement Design & Construction. 3 Hours.
Analysis of stresses and strains in pavement systems. Design and construction of flexible and rigid pavements, base courses and subgrades. Effects of loading on pavement life.

CE 544. Civil Engineering Analysis II. 3 Hours.
Sampling and experimental design. Hypotheses testing. Decision Analyses. Multiple regression analyses. Nonparametric methods. Analysis of experimental data in civil engineering research; regression, experimental design, non-parametrical analysis. CE 344 (Civil Engineering Analysis I) is suggested as a prerequisite for this course.

CE 553. Design of Wood Structures. 3 Hours.
This course will give students an understanding of structural wood materials, both sawn lumber and a number of engineered wood materials. The main objective of the course is to learn how to design wood structures using these materials, including the design of beams, columns, connections, roof diaphragms, and shear walls. The requirement of the National Design Specification for Wood Structures will be addressed.

CE 554. Design of Masonry Structures. 3 Hours.
Design and detailing of masonry structures. Nomenclature, properties, and specifications for components. Design of assemblages, simple masonry structures, unreinforced and reinforced elements, and complex masonry structures. CE 360 (Structural Analysis) is a prerequisite for this course.

CE 556. Prestressed Concrete Design. 3 Hours.
Principles and concepts of design in prestressed concrete including elasticand ultimate strength analysis for flexural, shear, bond, and deflections. Principles of concordancy and linear transformation for indeterminate prestressed structures. CE 455 (Reinforced Concrete Design) is a prerequisite for this course.
CE 557. Concrete Technology. 3 Hours.
Properties of concrete in relation to specifying, purchasing, and evaluating concrete materials. Fresh and hardened concrete properties. Concrete mix design procedures. Effects of finishing, curing, weather conditions, and various construction procedures. Ready mix concrete production and field placement techniques. Specifications writing to ensure good quality concrete and field inspection procedures. Case studies of problems in concrete construction. CE 222 (Civil Engineering Materials Laboratory) is a prerequisite for this course.

CE 560. Structural Mechanics. 3 Hours.
Elastic beam deflections, beam columns, lateral torsional buckling, column stability, plastic design, plate bending, yield line theory.

CE 561. Introduction to the Finite Element Method. 3 Hours.
Concepts and applications of the finite element method. Development and applications of basic finite elements. Software use.

CE 562. Advanced Structural Analysis. 3 Hours.
Analysis of indeterminate structures using classical and matrix methods. Use of large-scale computer programs. A grade of C or better in CE 360 (Computer Methods in Civil Engineering) or its equivalent is required.

CE 564. Structural Dynamics. 3 Hours.

CE 567. Wind and Seismic Loads. 3 Hours.
Methods for calculating loads on structures caused by extreme winds and earthquakes. Calculation of wind loads on various types of structures according to theory and codes. Determination of earthquake loads on structures using structural dynamics and codes. CE 360 (Structural Analysis) is a prerequisite for this course.

CE 568. Bridge Engineering. 3 Hours.
Bridge loads, steel beam bridges, composite beam bridges, bridge bearings, reinforced and prestressed concrete slab and T-beam bridges, bridge evaluations and ratings, upgrade methodologies; computer applications. CE 450 (Structural Steel Design) and CE 455 (Reinforced Concrete Design) are prerequisites for this course.

CE 570. International Research Experience. 3 Hours.
The International Research Experience for Students (IRES) program provides the opportunity for undergraduate and graduate students to participate in hands-on engineering research in an international setting. Students perform research on an approved topic related to civil engineering design in an international environment. Students select a topic, perform a detailed literature review, and work with mentors from UAB and the international host institution to develop research objectives and a detailed research plan. The course will culminate in a 6-8 week visit to the international host institution, during which time students will conduct hands-on research with their mentors and prepare final reports.

CE 575. Construction Safety and Health Management. 3 Hours.
This course covers various causes of construction accidents and the adopted strategies to prevent worksite injuries and illnesses. Other topics covered include workers' compensation, OSHA standards for the construction industry, economics of construction safety management, temporary structures, system safety, ergonomic applications, health hazards, and the development of a safety program.

CE 580. Introduction to Water and Wastewater Treatment. 3 Hours.
Physical unit operations, and chemical/biological unit processes for water and wastewater treatment. Design of facilities for treatment. Treatment and disposal of sludge. CE 236 (Environmental Engineering) is a prerequisite for this course.

CE 585. Engineering Hydrology. 3 Hours.
Hydrologic principles including hydrology cycle, precipitation data, and stream-flow measurements. Applications to engineering problems; stream-flow analysis and watershed management.

CE 590. Special Topics in Civil Engineering. 1-6 Hour.
Special Topic in Civil Engineering.

CE 591. Individual Study in Civil Engineering. 1-6 Hour.
Individual Study in Civil Engineering.

CE 600. Sustainable Construction. 3 Hours.
Study of sustainable construction techniques and best practices. Provides an understanding of the interdependencies between planning, designing, building, operating, and demolishing the built environment and their impacts on the natural environment. Course topics will include: (1) issues of resource efficiency, economics, ethics, waste, human health, environmental justice, and industrial ecology; (2) alternative practices that significantly reduce adverse environmental impacts of built infrastructure, and (3) explore past and present thinking of engineering practitioners in this newly emerging discipline.

CE 605. Project Management. 3 Hours.
Presents the theory and practice of project management as a distinct discipline with applications in time, cost, and performance management. Managerial, organizational, behavioral and cost benefit aspects of project management are covered, as well as various applied models for organizing, executing, and monitoring a project. Basic estimating techniques to determine cost and time for construction work packages are discussed followed by scheduling model techniques to include the Critical Path Method (CPM), Precedence Diagramming Method (PDM), Program Evaluation and Review Technique (PERT), and Gantt charts.

CE 607. Engineering Entrepreneurship. 3 Hours.
Course focuses on the entrepreneurial engineer—a new type of engineer who needs a broad range of business skills and knowledge above and beyond a strong science and engineering background. The course will introduce engineering students to the key aspects of engineering entrepreneurship including business planning, solving problems, risk taking, financing, marketing, and entrepreneurial leadership. The students will also be introduced to the many opportunities and challenges that accompany starting and operating an entrepreneurial venture. Entrepreneurial company leaders will present their experiences and share their leadership styles as part of the course.

CE 608. Green Building Design. 3 Hours.
Quantitative introduction to the principles of “Green Building Design”. Provides students an understanding of the interdependencies between economics, technology, design, building occupation and the subsequent impact on the natural environment. Course will emphasize green building materials, new technologies, and sustainable construction methods. Course also includes LEED Case Studies (industrial, commercial, residential, and institutional examples).

CE 610. The Engineered Environment. 3 Hours.
Fundamentals of environmental engineering as they apply to the construction of the built environment and contemporary issues faced by engineers in developing nations such as Egypt. Topics include air pollution, solid waste management, water treatment, environmental ethics, etc.

CE 612. Theory of Elasticity. 3 Hours.
Equations of linear reduction to plane stress, plane strain, and generalized plane strain. Aply and love stress functions in solution of problems.
CE 615. Theory of Elastic Stability. 3 Hours.
Static stability of bars, beams, trusses, and rigid frames. Dynamic stability of bars. Energy method applied to bucking problems. General theory of elastic stability. CE 220 (Mechanics of Solids) is a prerequisite for this course.

CE 617. Theory of Plates and Shells. 3 Hours.

CE 621. Transportation Engineering Seminar. 1 Hour.
Seminar focusing on student research and guest presentations of various topics of interest to graduate transportation engineering students.

CE 622. Traffic Flow Theory. 3 Hours.
Microscopic and macroscopic traffic flow characteristics. Traffic flow analytical techniques including car-following models, traffic stream models, shock wave analysis. Queuing analysis and gap acceptance. Simulation models for network analysis. CE 345 (Transportation Engineering) is a prerequisite for this course.

CE 623. Non-Motorized Transportation Design and Planning. 3 Hours.
Urban planning principles that support non-motorized transportation, local bicycle or pedestrian plans, non-motorized transportation safety related considerations, non-motorized transportation design including traffic calming techniques, procedures for capacity analysis of pedestrian facilities.

CE 624. Simulation Models for Transportation Applications. 3 Hours.
Basic concepts of simulation models for analysis and optimization of transportation systems. Experimentation with planning simulation models and traffic models for signal timing and capacity analysis. CE 345 (Transportation Engineering) is a prerequisite for this course.

CE 625. Intelligent Transportation Systems. 3 Hours.
Legal, institutional and planning issues. System architecture, telecommunication techniques, Advanced User Services, intermodal systems, deployment programs, cost and benefit evaluation.

CE 631. Environmental Law. 3 Hours.
Law as it applies to the practicing environmental engineer. New and emerging regulations.

CE 632. Industrial Waste and Wastewater Treatment. 3 Hours.
Solid wastes and wastewaters from various industries. Assessment of treatability, system design, and equipment selection.

CE 633. Solid and Hazardous Waste Management. 3 Hours.
Provides students a quantitative introduction to solid and hazardous waste characterizations, international regulations, and management options. Course topics to include (1) Solid waste management hierarchy (reduce, reuse, recycle, recovery, responsible disposal); (2) Dry tomb landfill design; and (3) Hazardous waste identification and treatment/disposal.

CE 636. Stormwater Pollution Management. 3 Hours.
Quality and quantity of stormwater. Receiving water problems and sources of pollutants. Runoff quality and quantity characterizations. Erosion control. Selection and design of controls; regulations.

CE 638. Water and Wastewater Chemistry. 3 Hours.

CE 639. Sediment Sources and Controls. 3 Hours.
Erosion and sediment transport areas; design of common erosion control practices.

CE 640. Wastewater Treatment Engineering. 3 Hours.
Wastewater sources and characteristics. Design and operation of wastewater treatment facilities, including grit removal, oil and grease removal, dissolved air flotation, activated sludge process, trickling filters, and rotating biological contractors, stabilization ponds and aerated lagoons, anaerobic processes for wastewater treatment and sludge digestion. Ultimate disposal of wastewater residues and considerations of discharge criteria.

CE 641. Civil Engineering Seminar. 0 Hours.
Seminar focusing on guest presentations of various civil and environmental engineering topics of interest for CE Masters students. Mandatory enrollment once prior to graduation.

CE 646. Traffic Engineering Operations. 3 Hours.
Highway and Intersection capacity analysis, traffic signal timing and phasing, coordination, freeway operations, non-signalized traffic control techniques. CE 345 (Transportation Engineering) is a prerequisite for this course.

CE 648. Urban and Transportation Planning. 3 Hours.
Land use planning for transportation systems; trip generation, trip distribution, and traffic assignment. CE 345 (Transportation Engineering) or an equivalent is a prerequisite for this course.

CE 649. Engineering Liability. 3 Hours.
Laws related to liability for engineering design in the context of product liability and construction projects; roles and liabilities between various parties involved in construction projects.

CE 650. Advanced Structural Steel. 3 Hours.
Beams, columns, tension members, and connections; current research. CE 450 (Structural Steel Design) or its equivalent is required.

CE 655. Advanced Reinforced Concrete. 3 Hours.
Beam, column, and slab actions; current research. CE 455 (Reinforced Concrete Design) or its equivalency is required.

CE 658. Engineering Management. 3 Hours.
Management techniques for the practicing engineer.

CE 663. Finite Element Methods. 3 Hours.
Theory and applications in structural mechanics. Plane stress, plane strain, axisymmetric problems, solids, plates, shells, nonlinear systems.

CE 681. Environmental Chemistry. 3 Hours.
Chemical equilibrium, acid/base, chemical concepts in pollutant behavior. Chemical kinetics, redox system, hydrolysis, pesticides, chemical wastes.

CE 682. Water Treatment Engineering. 3 Hours.
Water sources and characteristics. Design and operations of water treatment facilities. Topics include lime softening operations, coagulation, flocculation, clarification dissolved air flotation, filtration, disinfection, absorption, ion exchange and sludge management.

CE 683. Water and Wastewater Treatment Processes Lab. 3 Hours.
Construction and evaluation of bench-scale treatment processes. Treatability of water and wastewater. Coagulation of sedimentation, settleability of biological sludge, aerobic biological treatment, chemical treatment, water softening toxicity, disinfection, and sludge treatment processes.
CE 685. Engineering Hydrology. 3 Hours.
Hydrologic principles including hydrologic cycle, precipitation data, and stream-flow measurements. Applications to engineering problems; stream-flow analysis and watershed management. A grade of C or better in CE 337 (Hydraulics) or its equivalency is required.

CE 686. Engineering Hydrogeology. 3 Hours.
Groundwater movement, natural quality, contamination, and restoration. Physical and chemical properties of groundwater. Well hydraulics and flow net analyses. Prevention and control of groundwater contamination. CE 485 (Engineering Hydraulics) and MA 252 (Differential Equations) are required.

CE 687. Stormwater Detention Pond Design. 3 Hours.
Stormwater problems and control methods. Urban hydrology prediction procedures for drainage and water quality studies. Detention pond design basics, limitations and multiple benefits.

CE 688. Strategic Management and Leadership Applications in a Global Environment. 3 Hours.
This course is designed to prepare students to face the demanding management and leadership challenges facing construction and engineering industry leaders as competition becomes ever more globalized. The necessity to personally remain trained and relevant in the changing business environment is emphasized. Strong resume writing and oral interview skills are emphasized as a necessary skill for job seekers as well as job providers. Strategic planning, management and leadership in the built environment requires savvy leaders with exceptionally developed analytical and communications skills suitable for multi-disciplinary and multi-national ventures. Every individual and organization must continually innovate and reinvent to stay competitive. In a competitive environment, a strong working knowledge of the financial markets is essential and students are exposed to multiple lessons presented by financial industry practitioners. Students participate in a group project designed to reinforce the methodology associated with preparing and presenting a dynamic business plan. This course provides the opportunity for students to discuss and research these concepts and to recognize the necessity to think independently, challenge conventional thinking, and visualize alternatives.
Prerequisites: CE 669 [Min Grade: C]

CE 689. Building Information modeling (BIM) Techniques. 3 Hours.
This course provides students with an overview of the evolution of BIM technology in the construction industry followed by hands-on training in the basic application of contemporary BIM software. Students will learn basic modeling skills and how to produce graphical presentations. Advanced applications of BIM technology are discussed and demonstrated. Students will be provided with BIM software and are required to complete a multi-step BIM model as a term project.
Prerequisites: CE 669 [Min Grade: C]

CE 690. Special Topics in (Area). 1-3 Hour.
Special Topics (Area).

CE 691. Individual Study in (Area). 1-4 Hour.
Individual Study (Area).

CE 692. CE Capstone Project. 3 Hours.
This course covers specific contemporary topics related to civil engineering practice and knowledge. Capstone project using case studies to apply skills, knowledge, techniques, and concepts developed in prior courses.

CE 693. Applied Research in CEE. 3-9 Hours.
Research tools, including elements of experimental design and proposal preparation. Effective communication, literature searches, and exploratory data analysis. Prerequisite: permission of instructor.

CE 695. International Construction Contracts/Liability. 3 Hours.
Provides an overview of the fundamental aspects of the law that affects construction and engineering companies as well as the project owners. Particular emphasis is placed on contract forms and provisions related to liability for engineering design and construction companies, the roles of the typical participation in the process, and dispute resolution.

CE 697. Master's Project. 3-9 Hours.
A UAB Master's Project must demonstrate evidence of scholarly study and writing that ultimately contributes to the scientific knowledge base. This course is designed to allow students the opportunity to develop original ideas or seek to advance knowledge through theory, conceptualization, design, testing of tools, instruments, or procedures relevant to the practice of civil engineering.


Prerequisites: GAC M

CE 712. Theory of Elasticity. 3 Hours.
Equations of linear reduction to plane stress, plane strain, and generalized plane strain. Airy and love stress functions in solution of problems.

CE 715. Theory of Elastic Stability. 3 Hours.

CE 717. Theory of Plates and Shells. 3 Hours.

CE 721. Transportation Engineering Seminar. 1 Hour.
Seminar focusing on student research and guest presentation of various topics of interest to graduate transportation engineering students.

CE 722. Traffic Flow Theory. 3 Hours.
Microscopic and macroscopic traffic flow characteristics. Traffic flow analytical techniques including car-following models, traffic stream models, shock wave analysis. Queuing analysis and gap acceptance. Simulation models for network analysis.

CE 723. Non-Motorized Transportation Design and Planning. 3 Hours.
Urban planning principles that support non-motorized transportation, local bicycle or pedestrian plans, non-motorized transportation safety related considerations, non-motorized transportation design including traffic calming techniques, procedures for capacity analysis of pedestrian facilities.

CE 724. Simulation Models for Transportation Applications. 3 Hours.
Basic concepts of simulation models for analysis and optimization of transportation systems. Experimentation with planning simulation models and traffic models for signal timing and capacity analysis.

CE 725. Intelligent Transportation Systems. 3 Hours.
Legal, institutional and planning issues related to Intelligent Transportation Systems. System architecture, telecommunication technologies. Advanced User Services, intermodal systems, deployment, cost benefit evaluation.
CE 731. Environmental Law. 3 Hours.
Law as it applies to the practicing environmental engineer. New and emerging regulations.

CE 732. Industrial Waste and Wastewater Treatment. 3 Hours.
Solid wastes and waste waters from various industries; assessment of treatability, system design, and equipment selection.

CE 736. Stormwater Pollution Management. 3 Hours.
Quality and quantity of stormwater. Receiving water problems and sources of pollutants. Runoff quality and quantity characterizations. Erosion control. Selection and design of controls; regulations.

CE 738. Water and Wastewater Chemistry. 3 Hours.

CE 739. Sediment Sources and Controls. 3 Hours.
Erosion and sediment transport in urban areas, design of common erosion control practices.

CE 740. Wastewater Treatment Engineering. 3 Hours.
Wastewater sources and characteristics. Design and operation of wastewater treatment facilities, including grit removal, oil and grease removal, dissolved air flotation, activated sludge process, trickling filters, and rotating biological contactors, stabilization ponds and aerated lagoons, anaerobic processes for wastewater treatment and sludge digestion. Ultimate disposal of wastewater residues and considerations of discharge criteria.

CE 741. Civil Engineering Seminar. 0 Hours.
Seminar focusing on guest presentations on various civil and environmental engineering topics of interest for CE Ph.D. students. Mandatory enrollment at least once prior to graduation.

CE 749. Engineering Liability. 3 Hours.
Laws related to liability for engineering design in the context of product liability and construction projects; roles and liabilities between various parties involved in construction projects.

CE 750. Advanced Structural Steel. 3 Hours.
Beams, columns, tension members, and connections; current research.

CE 755. Advanced Reinforced Concrete. 3 Hours.
Beam, column, and slab actions; current research.

CE 758. Engineering Management. 3 Hours.
Management techniques for practicing engineers.

CE 763. Finite Element Methods. 3 Hours.
Theory and applications in structural mechanics. Plane stress, plane strain, axisymmetric problems, solids, plates, shells, nonlinear systems.

CE 781. Environmental Chemistry. 3 Hours.
Chemical equilibrium, acid/base, chemical concepts in pollutant behavior. Chemical kinetics, redox system, hydrolysis, pesticides, chemical wastes.

CE 782. Water Treatment Engineering. 3 Hours.
Water sources and characteristics. Design and operation of water treatment facilities including lime softening operations, coagulation, flocculation, clarification, dissolved air flotation, filtration, disinfection, absorption, ion exchange, and sludge disposal.

CE 783. Water and Wastewater Treatment Processes Lab. 3 Hours.
Construction and evaluation of bench-scale treatment processes. Treatability of water and wastewater. Coagulation of sedimentation, settleability of biological sludge, aerobic biological treatment, chemical treatment, water softening toxicity, disinfection, and sludge treatment processes.

CE 786. Engineering Hydrogeology. 3 Hours.

CE 787. Stormwater Detention Pond Design. 3 Hours.
Stormwater problems and control methods. Urban hydrology prediction procedures for drainage and water quality studies. Detention pond design basics, limitations and multiple benefits.

CE 790. Special Topics in (Area). 1-3 Hour.
Special Topics (In Area).

CE 791. Individual Studies (In Area). 1-4 Hour.
Individual Studies (In Area).

CE 793. Applied Research in Civil and Environmental Eng.. 3 Hours.
Research tools, including elements of experimental design and proposal preparation. Effective communication, literature searches, and exploratory data analysis.

CE 797. CCEE Internship. 6 Hours.
Off-campus internship experience working with industries, utilities or government agencies.


CE 799. Dissertation Research. 1-12 Hour.
Prerequisites: GAC Z

CECM-Construction Egr Mgmnt Courses

CECM 669. Advanced Project Management. 3 Hours.
Skills generally required for sound project management in a variety of management settings are studied in addition to specific management issues typically associated with engineering and construction companies. Students are introduced to the Project Management Institute's Body of Knowledge (PMBOK). A discussion of corporate organizational structures and the evolving use of project management processes helps establish an appreciation for the role of a Project Manager. The elements of a project and the role and responsibilities of the Project Manager are studied in depth. Students are also acquainted with risk management concepts, financial, labor, safety, equipment, and contracting issues facing managers in the engineering and construction environment. Particular emphasis is placed on individual management strengths and weaknesses, team building, and characteristics of successful companies. One of the primary vehicles for discussion will be small case studies from real companies and the outside reading of one or two relevant topical books.

CECM 670. Construction Estimating and Bidding. 3 Hours.
Provides an overview of typical construction delivery systems and the planning and contracting associated with each. A broad study of estimating methodologies ranging from rough "ball park" estimates to detailed unit pricing is presented focusing on labor, equipment, materials, subcontractors, job conditions, location, overhead, and profit. This course is intended to establish a basic understanding of the estimating process; and therefore, substantial course focus will be placed on the term group project.
CECM 671. Construction Liability & Contracts. 3 Hours.
This course provides an overview of the fundamental aspects of the laws that affect construction and engineering companies as well as the project owners. Particular emphasis is placed on contract forms and provisions related to liability for engineering design and construction companies, the roles of the typical participation in the process, and dispute resolution. Students will learn the importance of contract language negotiations and the impact of project risk transfer.
Prerequisites: CECM 669 [Min Grade: C] or CE 669 [Min Grade: C]

CECM 672. Construction Methods and Equipment. 3 Hours.
This course provides students a big-picture understanding of the construction methods employed to bring the concepts and designs of architects and engineers to physical reality. The International Building Code (IBC) is presented in the course material as are the fundamental principles of green building and sustainable design. Detailed study of typical building materials, design details, and construction methods are presented in a logical sequence. Students will understand the planning and deployment of equipment, materials, labor, and subcontractors using a variety of building material and system types. This course provides a necessary baseline of knowledge, vocabulary, and understanding of the role and activities of the designers, engineers, material suppliers, inspectors, and constructors in the commercial building process.

CECM 673. Project Planning and Control. 3 Hours.
This course provides a thorough understanding of the project scheduling process in construction planning and control. Students learn the relationship between the work breakdown structure, organization breakdown structure, and the activities used in developing project schedules. The Critical Path Method (CPM), Precedence Diagram Method (PDM), Program Evaluation and Review Technique (PERT), and Line of Balance (LOB) scheduling methods are discussed in detail to include hand calculations and powerful computer software products. The use of scheduling techniques for project control, resources constraint management, cash flow management, risk management, and project completion date management are investigated as is the importance of communications in the planning and monitoring/controlling processes. Students will experience hands on use with Primavera scheduling software.

CECM 674. Green Building Design/Construction. 3 Hours.
This course provides an introduction to the emerging trends in green building sustainable design and construction. The course will include instruction suitable to prepare students for the United States Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED©) Green Associates certification exam. Advanced applications of BIM technology will be discussed and demonstrated. Students will be provided with BIM software and will be required to complete a multi-step BIM model as a term project.

CECM 675. Advanced Construction and Engineering Economics. 3 Hours.
This course provides an extensive overview of financial and managerial accounting concepts for non-financial managers. Students will learn the basic elements of accounting (Generally Accepted Accounting Practices (GAAP)). They will understand how typical financial records and financial statements are established for companies. Once the basics are understood, students will study how financial data is used for internal cost controlling, planning, and budgeting. Fundamental financial calculations associated with the time value of money, debt instruments, taxes, inflation, and cash flow estimates are emphasized. Students will be expected to demonstrate proficiency in the use of Excel business functions in solving financial problems.

CECM 676. Construction Project Risk Management. 3 Hours.
This course addresses the methodologies employed in the engineering and construction industries to assist in rational decision-making in the face of uncertainty. The course reviews the fundamentals of common probabilistic theories and models, data sampling, hypothesis testing and the basics of Bayesian Decision Theory. In addition, basic financial analysis tools will be reviewed. Theoretical models will then be applied to specific examples encountered in engineering and construction decision making with emphasis on engineering economics applications.

CECM 678. Construction Management and Leadership Challenges in the Global Environment. 3 Hours.
This course is designed to prepare students to face the demanding management and leadership challenges facing construction and engineering industry leaders as competition becomes ever more globalized. The necessity to personally remain trained and relevant in the changing business environment is emphasized. Strong resume writing and oral interview skills are emphasized as a necessary skill for job seekers as well as job providers. Strategic planning, management and leadership in the built environment requires savvy leaders with exceptionally developed analytical and communications skills suitable for multi-disciplinary and multi-national ventures. Every individual and organization must continually innovate and reinvent to stay competitive. Students participate in a group project designed to reinforce the methodology associated with preparing and presenting a dynamic business plan. This course will provide the opportunity for students to discuss and research these concepts and to recognize the necessity to think independently, challenge conventional thinking, and visualize alternatives.
Prerequisites: CECM 670 and CECM 675

CECM 679. Building Information Modeling (BIM) Techniques. 3 Hours.
This course provides students with an overview of the evolution of BIM technology in the construction industry followed by hands-on training in the basic application of contemporary BIM software. Students will learn basic modeling skills and how to produce graphical presentations. Advanced applications of BIM technology will be discussed and demonstrated. Students will be provided with BIM software and will be required to complete a multi-step BIM model as a term project.

CESC-Sustainable Smart Cities Courses

CESC 600. Principles of Sustainable Development. 3 Hours.
The course will begin by discussing the concepts, viewpoints and fundamentals essential for understanding urban sustainable development agenda. This will be followed by the evaluation of international conferences and action items proposed by the scientific / professional community to advance sustainable smart cities development. You will review basic earth sciences to better evaluate the impact our anthropogenic activities have on the natural environment and therefore how to minimize adverse future outcomes. Throughout the course case studies of sustainable developments will be used to illustrate the value, challenges and limitations of this concept. In the end, you will possess the knowledge base needed to help advance sustainable smart cities development.
**CESC 602. Introduction to Sustainable Smart Cities. 3 Hours.**
This course introduces the issues surrounding sustainable development within cities and explores how the smart city concept can contribute to the urban sustainable development agenda. The course begins by considering the key characteristics of contemporary urbanization and the issues and challenges that these present for sustainability and urban environmental management. The meaning and nature of sustainability for cities will be discussed, followed by a consideration of the definitions of a smart city and a discussion of the key elements of a smart city including its contribution to both urban governance and the more effective and efficient management of natural resources. With reference to case studies the final part of the course will explore and evaluate the role that smart city processes and applications can play in enhancing the social, economic and environmental aspects of sustainable development within urban areas.

**CESC 604. Low-Carbon and Renewable Energy Systems for Smart Cities. 3 Hours.**
As the energy infrastructure is arguably the most important feature in any city energy efficiency and integration of renewable energy sources within urban areas are central to the smart city concept. This course will firstly explore why there is a need for the greater use of low carbon and renewable energy systems within cities, followed by an introduction to the range of low carbon and renewable energy technologies currently available. The course will then move on to introduce the concept of the smart grid and then explore the potential to integrate low carbon and renewable energy systems into smart grids in order to move towards cost-effective, efficient and more environmentally friendly energy provision within cities. Challenges and issues associated with the greater integration of low carbon and renewable energy systems into energy infrastructure within large urban areas will also be considered.

**CESC 606. Managing Natural Resources and Sustainable Smart Cities. 3 Hours.**
The course examines the challenges of resource use and management within the context of an urbanizing world, exploring how new concepts within the smart and sustainable city agenda may contribute to addressing these challenges. The course begins by considering contemporary patterns of resource use created by cities in the modern world at a variety of scales from the local to the global. New approaches in the form of ecosystem services and urban metabolism in relation to natural resource management are examined in terms of their contribution to developing a smart and sustainable city agenda. The course continues by exploring a selection of key natural resources challenges (e.g. water, energy, air quality and climate) and the development of new management approaches and strategies in these areas. The course concludes by examining the development of integrated environmental management systems and governance structures within which these new approaches can be implemented with reference to a series of case studies.

**CESC 608. Green Infrastructure and Transportation. 3 Hours.**
The course covers policy and technical issues related to sustainable transportation. The course begins by discussing the concepts, viewpoints and fundamentals essential for understanding sustainable transportation planning. Tools used to assess sustainability of transportation facilities and neighborhoods are introduced next. The course also presents design options in support of green infrastructure and transportation, including livable street design, and traffic calming applications. The course is expected to expand students’ knowledge base on sustainable transportation issues and help them understand the concept of sustainable transportation toward the development of sustainable smart cities.

**CESC 610. Health and Liveability. 3 Hours.**
This course will address the multidisciplinary aspects of urban environmental quality and its impact on human well-being. It will provide a critical appreciation of the factors which influence health, well-being and quality of life within contemporary urban environments, demonstrate the importance of genomics and health informatics in developing strategies for improving the health and well-being of urban citizens, explore the importance of urban design and the contribution of the development of food smart cities in improving both urban health and liveability, and understand the increasingly important role of ICT in facilitating delivery of effective and responsive urban health, well-being and quality of life strategies.

**CESC 612. Green Buildings. 3 Hours.**
The course will begin by discussing the concepts, viewpoints and fundamentals essential for understanding green building and construction. Discussions will then be focused on how key stakeholders and their future collaborations can begin to incorporate sustainable construction practices for the betterment of the project (new construction and inventory rehabilitation). This will be followed by the evaluation of sustainable construction rating systems (LEED, BREEAM, etc.) and how they can be applied to occupied buildings throughout an urban environment. Modular case studies of sustainable construction projects (individual structures to entire community developments) will be used to illustrate the value, challenges and limitations of this concept. In the end, students will possess an expanded knowledge base needed to help advance sustainable smart cities development.

**CESC 614. Smart Cities Technologies. 3 Hours.**
Smart Technologies.

**CESC 616. Big Data and Smart Cities. 3 Hours.**
The world is becoming increasingly digitally interconnected and this instrumentation, data collection, interconnection, storage, and analysis can provide the capacity to radically transform how cities monitor, manage and enhance their environmental quality and liveability. This course will provide an introduction to what big data is and how it can contribute to the smarter, more sustainable management of cities. The course will begin by discussing the concepts of big data and the big data revolution, and an overview of the ways in which data can be captured, stored and analyzed. This will be followed by a consideration of how big data can be used by city managers to optimize: their use of physical and digital infrastructures; their sustainable use of natural resources; citizen service delivery; and citizen engagement, participation and urban governance. You will also be introduced to some of the challenges presented by big data, both the technological challenges and the ethical and social implications associated with collecting, storing and using big data. Throughout the course case studies of big data in action will be used to illustrate the value, challenges and limitations of big data in the smarter, more sustainable management of cities.
CESC 618. Research Methods and Project Planning. 3 Hours.
As a student of smart city processes and urban environmental management you need to understand the research process which enables you to take the knowledge and skills which you have learned and apply it to a specific urban sustainability / environmental management issue. This course is not intended to provide a training in research techniques, but rather to make you aware of a wide range of investigative and analytical methods and techniques using examples drawn from the areas of smart city approaches, urban sustainability and environmental management. Both quantitative and qualitative methodologies and primary and secondary data collection will be covered. You will be encouraged to reflect on the research process and its outcomes by critiquing research papers written from methodological standpoints. You will then apply this knowledge to create a viable research proposal for your own Sustainable Smart Cities Masters project. This proposal will require you to identify and justify for your chosen topic: (i) appropriate research questions, (ii) methodologies and data sampling / collection techniques, (iii) ethical and health and safety implications and, (iv) a timetable of action.

CESC 620. Sustainable Smart Cities Research Project. 0 Hours.
This course will develop skills in both research and technical writing in the area of applying and/or evaluating sustainable smart cities processes and policies to a specific urban environmental or sustainability issue. The research proposal produced as part of the Research Methods and Project Planning course will be implemented. This will involve further research into the relevant background and context of a chosen project topic, implementation and evaluation of appropriate methods for collecting and analyzing data, observations and information, the ability to present findings clearly and concisely, and appreciate their significance in relation to the smart city and sustainable urban management agendas. Research should be at the forefront of student’s chosen sustainable smart cities research topic and be at a level similar to that required for acceptance and presentation at a national level conference or symposium on smart and sustainable cities. For students in relevant employment, projects may be carried out in your place of work subject to discussions between you, your employer/line manager, and your project supervisor.

CESE - Structural Engineering Courses

CESE 650. Wood and Masonry Design. 3 Hours.
Design of wood structures to meet the requirements of the National Design Specification including beams, columns, and shear walls. Design and detailing of masonry structures. Nomenclature, properties, and specifications for components. Design of assemblages and masonry elements in simple masonry structures.
Prequisites: CE 455 [Min Grade: C]

CESE 655. Advanced Mechanics of Materials for Structural Engineering. 3 Hours.
This course will review the basic fundamentals of mechanics of materials and will extend the concepts to include 3 dimensional stress and strain, plastic behavior, energy methods, nonlinear behavior, fatigue and fracture, rectangular linear elastic plates, indeterminate structures and stability.

CESE 657. Advanced Design of Steel Structures. 3 Hours.
Design of major components in steel-framed buildings, including composite beams and slabs, beam-columns, moments connections, bracing members, bracing connections, and column base plates.

CESE 659. Advanced Reinforced Concrete. 3 Hours.
In this course students will study the behavior and design of continuous reinforced concrete structures submitted to gravity and lateral loads. The study will include biaxial loading of columns, continuous one-way beams and slabs two-way floor systems, and torsion loading.

CESE 660. Prestressed Concrete Behavior and Design. 3 Hours.
The course will explore the characteristics and design of pre-stressed concrete structural components to include elastic and ultimate strength analyses for flexural, shear, torsion, deflection, strand bond, and pre-stress loss.

CESE 662. Advanced Structural Analysis. 3 Hours.
This course explores the structural analysis of indeterminate structures using classical and approximate methods and structural analysis software. Specific emphasis is placed on the determination of forces in typical multistory, rectilinear frames subject to gravity and lateral loads. In addition to first order analysis, the course included analysis for second order effects and plastic analysis.

CESE 664. Bridge Engineering. 3 Hours.
This course includes the study of bridge loads, including moving load analysis; methods for approximate structural analysis, preliminary bridge design methods, and the structural design of bridge decks and girders.

CESE 665. Structural Dynamics and Earthquake Engineering. 3 Hours.
This course includes the study of earthquake-induced vibrations of single and multi-degree-of-freedom systems, such as single and multistory frames. Emphasis will be placed on structural steel and reinforced concrete building frames. Response spectrum analysis will be investigated as well as building codes and static and dynamic lateral load force procedures.

CESE 676. Design of Structural Steel Connections. 3 Hours.
Design of bolted and welded steel connections, including shear, moment and brace connections using the AISC Specifications requirements and fundamental engineering principals. Design procedures will be discussed for various structural steel connections. The background and limitations of the design procedures will be reviewed and practical solutions will be provided.

CESE 690. Special Topics (Area). 1-3 Hour.
Special Topics (Area).

CESE 698. Non Thesis Research. 3 Hours.
No syllabus for non-thesis research hours.