Civil Engineering

The Department of Civil, Construction, and Environmental Engineering (CCEE) offers master's and doctoral level programs as well as graduate certificates. Graduate students are exposed to cutting-edge research covering various facets of civil engineering theory and practice. Knowledgeable and experienced faculty members work closely with students to provide them with the tools required to succeed professionally in globally competitive work environments.

Program	Coordinator	Room	Phone Number
Certificates	Nasim Uddin, PhD	Hoehn Engineering Building, Room 321	(205) 934-8432; nuddin@uab.edu

Category A certificates are offered by the Department of Civil, Construction, and Environmental Engineering. Any undergraduate or graduate student in good standing who is pursuing a Civil Engineering degree (BSCE, MSCE, or 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:

- Construction Engineering Management
- Environmental Engineering
- Geotechnical Engineering
- Structural Engineering
- Sustainable Engineering
- Transportation 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.

The requirements are as follows:

- Students must be admitted to the Department as either undergraduate (BSCE) or graduate (MSCE) students in Civil, Construction, and Environmental Engineering or hold a BS in Civil Engineering or a closely related field from an accredited institution.
- Certificates require a minimum of 15 credit hours consisting of five graduate level elective courses in the area of specialization. Certificates for undergraduate students will be awarded upon completion of the BSCE degree.
- Graduate level elective courses taken may be applied to the certificate as well as a MSCE degree.
- One course, up to three credit hours, may be transferred from another institution.
- Courses taken from University of Alabama, University of South Alabama, and University of Alabama in Huntsville via Intercampus Interactive Telecommunications System (IITS) may be applied to certificates with prior approval of the certificate program director.
- Elective course may be taken at the 500, 600, or 700 level. Special topics courses (CE 590, CE 690, CE 790) may be applied to certificates with prior approval of the certificate program director.

Certificate in Construction Engineering Management

Requirements		Hours
Prerequisite Course		
CE 497	Construction Engineering Management (or equivalent)	
Select 15 credits from the following:		**15**
CE 575	Construction Safety and Health Management	
CE 600	Sustainable Construction	
CECM 669	Advanced Project Management	
CECM 670	Construction Estimating and Bidding	
CECM 671	Construction Liability & Contracts	
CECM 672	Construction Methods and Equipment	
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 688	Construction Management and Leadership Challenges in the Global Environment	
CECM 689	Building Information Modeling (BIM) Techniques	

Certificate in Environmental Engineering

Requirements		Hours
Prerequisite Courses		
CE 236	Environmental Engineering (or equivalent)	
CE 337	Hydraulics (or equivalent)	
Select 15 credits from the following:		**15**
CE 530	Water Supply/Drainage Design	
CE 533	Solid and Hazardous Wastes Management	
CE 534	Air Quality Modeling and Monitoring	
CE 580	Introduction to Water and Wastewater Treatment	
CE 608	Green Building Design	
CE 640	Wastewater Treatment Engineering	
CE 685	Engineering Hydrology	
CESC 600	Principles of Sustainable Development	
CESC 602	Introduction to Sustainable Smart Cities	

Certificate in Geotechnical Engineering

Requirements		Hours
Prerequisite Course		
CE 332	Soil Engineering (or equivalent)	
CE 332L	Soil Engineering Laboratory (or equivalent)	
Select 15 credits from the following:		**15**
CE 516	Mechanical Vibrations	
CE 520	Advanced Mechanics	
CE 526	Foundation Engineering	
CE 560	Structural Mechanics	
CE 562	Advanced Structural Analysis	
CE 567	Wind and Seismic Loads	
CE 690	Special Topics in (Area) [1]	
CECM 669	Advanced Project Management	
CECM 671	Construction Liability & Contracts	

[1] Must be approved by certificate program director prior to registration

Certificate in Structural Engineering

Requirements		Hours
Prerequisite Course		
CE 360	Structural Analysis (or equivalent)	
Select 15 credits from the following:		**15**
CE 516	Mechanical Vibrations	
CE 520	Advanced Mechanics	
CE 526	Foundation Engineering	
CE 553	Design of Wood Structures	
CE 556	Prestressed Concrete Design	
CE 561	Introduction to the Finite Element Method	
CE 562	Advanced Structural Analysis	
CE 564	Structural Dynamics	
CE 567	Wind and Seismic Loads	
CE 568	Bridge Engineering	
CE 650	Advanced Structural Steel	
CE 655	Advanced Reinforced Concrete	
CESE 653	Wood and Masonry Design	
CESE 656	Advanced Mechanics of Materials for Structural Engineering	
CESE 659	Advanced Reinforced Concrete	
CESE 660	Prestressed Concrete Behavior and Design	
CESE 662	Advanced Structural Analysis	
CESE 664	Bridge Engineering	
CESE 665	Structural Dynamics and Earthquake Engineering	
CESE 676	Design of Structural Steel Connections	
CESC 602	Introduction to Sustainable Smart Cities [1]	
CESC 608	Green Infrastructure and Transportation [1]	
CESC 614	Smart Cities Technologies [1]	

[1] Only one of these courses can be applied to this certificate

Certificate in Sustainable Engineering Management

Requirements		Hours
Prerequisite Course		
CE 497	Construction Engineering Management (or equivalent)	
Select 15 credits from the following:		**15**
CE 600	Sustainable Construction	
CE 608	Green Building Design	
CESC 600	Principles of Sustainable Development	
CESC 602	Introduction to Sustainable Smart Cities	
CESC 608	Green Infrastructure and Transportation	
CESC 610	Health and Livability	
CESC 614	Smart Cities Technologies	
CESC 616	Big Data and Smart Cities	

Certificate in Transportation Engineering

Requirements		Hours
Prerequisite Course		
CE 345	Transportation Engineering (or equivalent)	
Select 15 credits from the following:		**15**
CE 543	Pavement Design & Construction	
CE 622	Traffic Flow Theory	
CE 623	Non-Motorized Transportation Design and Planning	
CE 624	Simulation Models for Transportation Applications	
CE 625	Intelligent Transportation Systems	
CE 646	Traffic Engineering Operations	
CE 648	Urban and Transportation Planning	
CE 690	Special Topics in (Area) [1]	
CECM 669	Advanced Project Management [2]	
CECM 671	Construction Liability & Contracts [2]	
CESC 600	Principles of Sustainable Development [2]	
CESC 602	Introduction to Sustainable Smart Cities [2]	
CESC 608	Green Infrastructure and Transportation [2]	

[1] Must be approved by certificate program director prior to registration
[2] Only one of these courses can be applied to this certificate

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
- Sustainable Smart Cities

Construction Engineering Management Concentration

Please Note: All Master of Engineering concentrations are 100% online. There are no on-campus classes or required on-campus meetings or activities. Course delivery includes asynchronous and synchronous learning modes. Proper computer equipment and high-speed internet direct access are required to be successful.

Degree Offered	Master of Engineering
Website	http://www.uab.edu/engineering/cem
Director	Wesley Zech, PhD, LEED AP
Email	zechwes@uab.edu
Director of CEM Student Affairs	Dianne Gilmer, MEng, PMP
Email	digilmer@uab.edu
Phone	205-975-5848
Address	UAB School of Engineering, HOEN 130B
	1720 2nd Avenue South, Birmingham, AL 35294-4440

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

Admission Requirements

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

1. **Bachelor's degree** (any discipline) from a regionally accredited US college or university. CEM promotes a multi-discipline learning

experience and therefore an engineering undergraduate degree is not required;
2. An **undergraduate GPA** of 3.0 or higher (individuals not meeting this requirement but who have a strong professional background, references, and interview may be admitted);
3. **No GRE required**;
4. International applicants must submit **English proficiency scores** in accordance with UAB Graduate School requirement. Click here for details;
5. **Original transcripts** sent directly to the UAB Graduate School per their policy for degree-seeking students (detailed instructions are included during the online application process);
6. Two years of **relevant construction industry work experience** or a bachelor's degree in engineering or a science-related field;
7. **Personal interview** with the Director of CEM Student Affairs (schedule the interview prior to submitting a application);
8. Three **letters of recommendation** from professional contacts;
9. **Personal essay** detailing motivation and career aspirations for earning the degree; and
10. **Résumé/Curriculum Vitae**

To apply: Visit the UAB Graduate School website and click the 'Apply Now' button. Choose MEng - Construction Engineering Management in the *Program Applying To* section.

Pre-Defined Table

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

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

Sustainable Smart Cities Concentration

Please Note: All Master of Engineering concentrations are 100% online. There are no on-campus classes or required on-campus meetings or activities. Course delivery includes asynchronous and synchronous learning modes. Proper computer equipment and high-speed internet direct access are required to be successful.

Degree Offered	Master of Engineering
Website	http://www.uab.edu/engineering/smartcities
Director	Jason T. Kirby, PhD
E-mail	jtkirby@uab.edu
Phone	205-934-8479
Address	UAB School of Engineering, HOEN 340 1720 2nd Avenue South, Birmingham, AL 35294-4440

Admission Requirements

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

- Bachelor's degree (any discipline) from a regionally accredited US college or university. SSC promotes a multi-discipline learning experience and therefore an engineering undergraduate degree is not required;
- An undergraduate GPA of 3.0 or higher (individuals not meeting this requirement but who have a strong professional background, references, and interview may be admitted);
- No GRE required
- International applicants must submit English proficiency scores in accordance with UAB Graduate School requirement. Click here for details;
- Original transcripts sent directly to the UAB Graduate School per their policy for degree-seeking students (detailed instructions are included during the online application process);
- Personal interview with the Director of SSC (schedule the interview prior to submitting a application);
- Three letters of recommendation from professional contacts;
- Personal essay detailing academic motivation and career aspirations in SSC; and
- Résumé/Curriculum Vitae

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

Requirements		Hours
CESC 600	Principles of Sustainable Development	3
CESC 602	Introduction to Sustainable Smart Cities	3
CESC 604	Low-Carbon and Renewable Energy Systems for Smart Cities	3
CESC 606	Managing Natural Resources and Sustainable Smart Cities	3
CESC 608	Green Infrastructure and Transportation	3
CESC 610	Health and Livability	3
CESC 612	Green Buildings	3
CESC 614	Smart Cities Technologies	3
CESC 616	Big Data and Smart Cities	3
CESC 618	Research Methods and Project Planning	3
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, admission to the Master's 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 recommendation concerning the applicant's previous academic and professional work;
4. Original transcripts from all colleges and universities attended since high school must be sent directly to the UAB Graduate School (detailed instructions are included during the online application process)
5. International applicants must submit English proficiency scores in accordance with UAB Graduate School requirement. Click here for details
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. A full-time student is one who is enrolled in at least 9 credit hours per semester.

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 credit hours of Special Topics and/or Independent Study courses will be applied to the MSCE degree 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-elevel 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)

When a Plan I student successfully completes required coursework, the student should apply to enter candidacy. Once a master's candidate, the student must complete a minimum of 9 credit hours of thesis research (CE 699) over the course of at least two semesters. Prior to admission of candidacy, the student can take research credit hours in the form of non-thesis research (CE 698). These non-thesis research credit hours cannot be converted from non-thesis research credits into thesis research credits.

1. The student must successfully complete at least 22 credit hours of graduate credit, including:
   a. A minimum of 18 credit hours in civil engineering;
   b. Up to 6 credit hours in disciplines outside civil engineering, such as other engineering disciplines, mathematics, chemistry, computer science, earth science, physics, urban affairs, public administration, or public health; and
   c. A minimum of 9 credit hours of CE 699 Thesis Research under the direction of the graduate study committee chair resulting in a successful oral defense and committee approved thesis.
2. All Plan I Master's students are required to complete online modules covering the 9 topic areas of Responsible Conduct of Research (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 credit hours of graduate credit including:

1. A minimum of 24 credit hours in civil engineering;
2. Up to 6 credit hours in disciplines outside civil engineering, such as other engineering disciplines, mathematics, chemistry, computer science, earth science, physics, urban affairs, public administration, or public health; and
3. A minimum of 3 credit hours of CE 698 Non-Thesis Research under the direction of the graduate study committee chair resulting in a successful oral defense and committee approved written report.

Areas of Specialization

The department offers specialization programs in the fields of construction engineering management, environmental engineering, structural engineering/structural mechanics, and transportation engineering. Supporting courses are offered in geotechnical 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 credit hours (Plan I) or 24 credit hours (Plan II) within civil engineering.

Concentration in Construction Engineering Management

Requirements		Hours
Select 18 credits hours for Plan I or 24 credit hours for Plan II from the following: [1]		
CE 515	Building Information Modeling (BIM) [1]	

CE 575	Construction Safety and Health Management
CE 597	Construction Engineering Management
CE 600	Sustainable Construction
CE 690	Special Topics in (Area) [2]
CE 691	Individual Study in (Area) [2]
CECM 669	Advanced Project Management [3]
CECM 670	Construction Estimating and Bidding [3]
CECM 671	Construction Liability & Contracts [3]
CECM 672	Construction Methods and Equipment [3]
CECM 673	Project Planning and Control [3]
CECM 674	Green Building Design/Construction [3]
CECM 675	Advanced Construction and Engineering Economics [3]
CECM 676	Construction Project Risk Management [3]
CECM 688	Construction Management and Leadership Challenges in the Global Environment [3]
CECM 689	Building Information Modeling (BIM) Techniques [1, 3]

1 Only one of these courses can be applied to this degree

2 or any CE 590/690 IITS course offerings from UA, USA, or UAH campuses with prior approval of the Program Director. Please note: all special topics and individual study courses must have prior approval of the program director in order to apply to degree or concentration requirements; no more than a combined 6 hours of special topics or individual study can be applied to the degree without prior program director approval

3 MEng courses (i.e., CECM, CESE, and CESC) can be applied toward MSCE degree requirements

Concentration in Environmental Engineering

Requirements		Hours
Select 18 credit hours for Plan I or 24 credit hours for Plan II from the following:		
CE 530	Water Supply/Drainage Design	
CE 531	Energy Resources	
CE 533	Solid and Hazardous Wastes Management	
CE 534	Air Quality Modeling and Monitoring	
CE 537	Environmental Experimental Design and Field Sampling	
CE 580	Introduction to Water and Wastewater Treatment	
CE 585	Engineering Hydrology	
CE 590	Special Topics in Civil Engineering [2]	
CE 600	Sustainable Construction [1]	
CE 608	Green Building Design	
CE 610	The Engineered Environment	
CE 636	Stormwater Pollution Management	
CE 640	Wastewater Treatment Engineering	
CE 690	Special Topics in (Area) [2]	
CE 691	Individual Study in (Area) [1]	
CESC 600	Principles of Sustainable Development	
CESC 602	Introduction to Sustainable Smart Cities [2, 3]	
CESC 608	Green Infrastructure and Transportation [2, 3]	

1 or any CE 590/690 IITS course offerings from UA, USA, or UAH campuses with prior approval of the Program Director. Please note: all special topics and individual study courses must have prior approval of the program director in order to apply to degree or concentration requirements; no more than a combined 6 hours of special topics or individual study can be applied to the degree without prior program director approval

2 MEng courses (i.e., CECM, CESC, CESE) can be applied to the MSCE degree requirements

3 Only one of these courses can be applied to this degree

Concentration in Structural Engineering

Requirements		Hours
Select 18 credit hours for Plan I or 24 credit hours for Plan II from the following:		
CE 516	Mechanical Vibrations	
CE 520	Advanced Mechanics	
CE 526	Foundation Engineering	
CE 544	Civil Engineering Analysis II	
CE 553	Design of Wood Structures	
CE 554	Design of Masonry Structures	
CE 556	Prestressed Concrete Design	
CE 557	Concrete Technology	
CE 560	Structural Mechanics	
CE 561	Introduction to the Finite Element Method	
CE 562	Advanced Structural Analysis	
CE 564	Structural Dynamics	
CE 568	Bridge Engineering	
CE 590	Special Topics in Civil Engineering [2]	
CE 612	Theory of Elasticity [1]	
CE 617	Theory of Plates and Shells	
CE 650	Advanced Structural Steel	
CE 655	Advanced Reinforced Concrete	
CE 690	Special Topics in (Area) [2]	
CE 691	Individual Study in (Area) [1]	
CESC 602	Introduction to Sustainable Smart Cities [3]	
CESC 608	Green Infrastructure and Transportation [2]	
CESC 614	Smart Cities Technologies [2]	

1 or any CE 590/690 IITS course offerings from UA, USA, or UAH campuses with prior approval of the Program Director. Please note: all special topics and individual study courses must have prior approval of the program director in order to apply to degree or concentration requirements; no more than a combined 6 hours of special topics or individual study can be applied to the degree without prior program director approval

2 MEng courses (i.e., CECM, CESC, CESE) can be applied to MSCE degree requirements

Concentration in Transportation Engineering

Requirements		Hours
Select 18 credit hours for Plan I or 24 credit hours for Plan II from the following: [1]		
CE 543	**Pavement Design & Construction (Select 18 credit hours for Plan I or 24 credit hours for Plan II from the following:)**	**3**
CE 590	Special Topics in Civil Engineering [2]	
CE 621	Transportation Engineering Seminar [1]	
CE 622	Traffic Flow Theory	
CE 624	Simulation Models for Transportation Applications	
CE 625	Intelligent Transportation Systems	
CE 646	Traffic Engineering Operations	
CE 648	Urban and Transportation Planning	

CE 690	Special Topics in (Area) [2]
CE 691	Individual Study in (Area) [1]

[1] or any CE 590/690 IITS course offerings from UA, USA, or UAH campuses with prior approval of the Program Director. Please note: all special topics and individual study courses must have prior approval of the program director in order to apply to degree or concentration requirements; no more than a combined 6 hours of special topics or individual study can be applied to the degree without prior program director approval

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 designate all the courses in which students may enroll. Therefore, the lists above are not all-inclusive.

Admission Requirements

The coordinated Environmental Engineering/Public Health degree program is offered through the UAB School of Engineering (SOE) and UAB School of Public Health (SOPH). Earning these two advanced degrees prepares students for a broad range of careers in urban planning, urban sustainability, healthy and livable city design, the management of air, water, and land resources, and creating healthy communities. Students in this coordinated program earn a Master of Public Health (M.P.H.) with a concentration in Population Health. In this concentration, students gain a solid foundation in public health through completion of the M.P.H. core (based on the Evidence-based Public Health framework), an Applied Practice Experience (Internship), and an Integrative Learning Experience (Capstone). Students also complete environmental health sciences courses focusing on urban health issues including air and water pollution, occupational safety, and assessing and managing environmental risks. In addition, in this coordinated degree program students earn a Master of Science in Civil Engineering (MSCE) with a specialization in environmental engineering focusing green building and water supply design, drainage and stormwater runoff design, and energy resources. The program offers a broad curriculum covering health aspects of engineering designs, resilient and sustainable urban development, low carbon and renewable energy systems, green infrastructure, natural resource management, health and livability, transportation and mobility, big data analytics, and smart technologies. Graduates of this coordinated degree program will shape our modern cities into human habitats that are safe, clean, and sustainable addressing issues such as the growing stressors of energy security, population growth and health, food supply, waste disposal, climate change, and future infrastructure demands. This program is aimed at leaders and professionals in public and private sector organizations who seek to design, develop, and deliver smart, healthy and sustainable environmental solutions.

In addition to the UAB Graduate School admission requirements, admission to the dual Master's of Science in Civil Engineering (MSCE)/ Master’s of Public Health (MPH) degree include the following five criteria:

1. An undergraduate engineering degree from an ABET accredited engineering program, applied science program, or similar. Applicants who have a degree from an unaccredited program but demonstrate an outstanding academic record may be admitted provisionally at the CCEE Graduate Program Director’s discretion. Students admitted from this category may be required to complete a sequence of undergraduate courses in addition to the regular requirements of the MSCE degree. This set of extra requirements will be specified in writing at the time of admission to the program.
2. An undergraduate GPA of 3.0 or higher on a 4.0 scale in all undergraduate degree major courses attempted. Individuals not meeting this requirement but who have a strong professional background and excellent references may be admitted.
3. Three (3) letters of recommendation concerning the applicant's previous academic and professional work.
4. **No GRE required**.
5. International applicants must submit English proficiency scores in accordance with UAB Graduate School requirement. Click here for details.
6. Verification of registration by examination as a Professional Engineer (PE) will satisfy criterion 2 above.

Master of Science in Civil Engineering/Master of Public Health Program Requirements

The following minimum requirements apply to the plan of study for a student who has earned a baccalaureate degree in civil engineering (BSCE). The MSCE/MPH degree plan contains 42-44 MPH credit hours meeting the Council on Education for Public Health (CEPH) MPH requirements and include PUH 610 Population Health meeting the SOPH requirement for the MPH in Population Health. 2) The MSCE/MPH degree plan contains 33 MSCE credit hours meeting the SOE MSCE requirements and have at least 30 credit hours unique to each Master‘s degree satisfying the UAB Graduate School requirements.

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 semester is required. Students receiving a research assistantship are required to be enrolled as full-time students. A full-time student is one who is enrolled in at least 9 credit hours per semester.

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 credit hours of Special Topics and/or Independent Study courses will be applied to the MSCE degree without appeal to and approval from the Program Director.

The SOE 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-elevel course for credit if they have previously taken the related 400-level or 600 level course, respectively.

When the graduate student successfully completes required coursework, the student opted for Plan I (Thesis Option) should apply to enter candidacy. Once a master’s candidate, the student must complete a minimum of 9 credit hours of thesis research (CE 699) over the course of at least two semesters. Prior to admission of candidacy, the student can take research credit hours in the form of non-thesis research credit hours (CE 698). These non-thesis research credit hours cannot be converted from non-thesis research credits into thesis research credits.

MSCE/MPH Curriculum

Requirements		Hours
MPH Core Requirements		14
PUH 601	This is Public Health	

PUH 602	Community Assessment	
PUH 603	Quantitative Methods in Public Health	
PUH 604	Programs and Policies	
PUH 605	Public Health Management and Evaluation	
PUH 606	Leadership for Evidence-Based Public Health	
MPH Degree Requirement		1
ENH 690	Environmental Health Perspectives	
Population Health Requirement		3
PUH 610	Population Health	
Environmental Health Sciences Recommended Courses [1]		7
ENH 600	Fundamentals of Environmental Health Science	
ENH 612	Assessing & Managing Environmental Risks	
ENH 660	Fundamentals of Air and Water Pollution	
MPH Applied Practice Experience		3
PUH 688	Public Health Internship	
MPH Integrative Learning Experience		2
ENH 689	Environmental Health Sciences Integrative Learning Experience	
Total Hours Earned for MPH Degree: 30 [3]		
MPH Shared Hours from MSCE Curriculum [4]		18
CE 580	Introduction to Water and Wastewater Treatment	
CE 585	Engineering Hydrology	
CE 530	Water Supply/Drainage Design	
CE 608	Green Building Design	
Total Hours Earned for MPH Degree [3]		
Remaining MSCE Program Requirements		18
CE 531	Energy Resources	
CE 537	Environmental Experimental Design and Field Sampling	
CE 731	Environmental Law	
CE 699	Thesis Research [5, 6]	
Total Unique MSCE Hours: 30 [2]		
MSCE Shared Hours from MPH Curriculum		
ENH 612	Assessing & Managing Environmental Risks	
Total Hours Earned for MSCE Degree [7]		
Total Hours Completed for MSCE/MPH Degree [8]		

1. Students may substitute ENH courses to meet their educational objectives with consent of advisor (7 credit hours minimum required)
2. Meets UAB Graduate School requirements of a minimum 30 hours of graduate work
3. Meets the CEPH MPH requirements of a minimum of 42 semester hours
4. Course substitutions may be made with consent of advisor
5. EHS faculty will serve on thesis committee
6. For Thesis students; Non-Thesis students will register for a total of 6 credit hours of CE electives and 3 credit hours of CE 698 Non-Thesis Research
7. Master of Science in Engineering
8. Assumes the recommended Environmental Health Sciences courses plus PUH 610 Population Health (12 credit hours)

Admission Requirements

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

1. An **undergraduate engineering degree** from an ABET accredited program **or a master's degree in engineering**. 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 or master's 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 or graduate courses in addition to the regular requirements of the MSCE degree. This set of extra requirements will be specified in writing at the time of admission to the program;
2. An **undergraduate GPA** of 3.0 or higher on a scale of 4.0 in all undergraduate degree major courses attempted. Individuals not meeting this requirement but who have a strong professional background and excellent references may be admitted;
3. Three (3) **letters of recommendation** concerning the applicant's previous academic and professional work;
4. No GRE required
5. International applicants must submit **English proficiency scores** in accordance with UAB Graduate School requirement. Click here for details.
6. Verification of registration by examination as a Professional Engineer (PE) will satisfy criterion 2.

Doctor of Philosophy in Civil Engineering Program Requirements

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 with contingencies and must remedy deficiencies in their preparation after the start of their academic program. These requirements will be defined in writing at the time of admission.

The program requires 48 credit hours of coursework beyond the baccalaureate level or 27 credit hours of coursework beyond the master's degree, plus a minimum of 24 credit hours of dissertation research (CE 799 Dissertation Research).

A minimum of 6 credit hours must be taken from the UAH campus. The student has two options

1. Register at UAH and then have the credits transferred to UAB or
2. Register at UAB for an equivalent course and have the UAH instructor send the grade to UAB.

The courses may be taken through the Intercampus Interactive Telecommunications System (IITS) at UAB, Distance Learning (DL), or web-based instruction for UAH.

Special Topics (690/790) courses and Individual Study (691/791) courses are reviewed for degree applicability for each program in the School of Engineering. No more than 6 combined credit hours of Special Topics and/or Independent Study courses will be applied to the degree without appeal to and prior 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-elevel course for credit if they have previously taken the related 400-level or 600 level course, respectively.

Doctoral students are also required to successfully complete GRD 717 Principles of Scientific Integrity prior to admission to candidacy.

A Graduate Study Committee must be established by the doctoral student and must include a minimum of five graduate faculty members, at least one of which must be from UAH. A comprehensive examination is required of all doctoral candidates. This examination is conducted by the Graduate Study Committee after all coursework is successfully completed. The examination has both written and oral components. During the oral portion of the examination, the student also presents the dissertation proposal to the Graduate Study Committee. The comprehensive examination may only be taken twice.

When the graduate student successfully passes the comprehensive examination, including the dissertation proposal, the student should apply to enter candidacy. Once a doctoral candidate, the student must complete a minimum of 24 credit hours of dissertation research (CE 799 Dissertation Research) over the course of at least two semesters. Prior to admission of candidacy, the student can take research hours in the form of non-dissertation credit hours (CE 798 Non-Dissertation Research); these non-dissertation credit research hours cannot be converted from non-dissertation research credit hours into dissertation research credit hours.

After successful completion of a minimum of 24 credit hours of dissertation research, the graduate student must complete the dissertation and submit to the Graduate Study Committee for review. The doctoral candidate must also present an oral public defense of the dissertation. When the graduate student successfully defends the dissertation, the student then has ten working days to complete revisions and submit the approved document to the Graduate School.

Required coursework must be selected from the list below. PhD students are encouraged to take the highest level available (700 level rather than 600 level; 600 or 700 level rather than 500 level). Students are only allowed to take 500 level courses if there is no equivalent 600 or 700 level course available. A minimum of 50 percent of the required coursework must be at the graduate level of 600 or above.

Additional graduate courses can be counted towards the PhD degree, as long as those courses were taken above and beyond the requirements for a BS or MS degree. To do so requires that the student must petition the department to have those courses counted toward an advanced degree. The graduate program director would make a recommendation on the petition (and would consider the UAB equivalent course description if the course was taken from another university). The maximum credit hours from an outside institution that could be applied toward an advanced degree at UAB is 12 credit hours.

Requirements		Hours
Required Courses		
GRD 717	Principles of Scientific Integrity	3
CE 799	Dissertation Research [1]	24
Construction Engineering Management Courses [2]		
CE 515	Building Information Modeling (BIM) [3]	
CE 575	Construction Safety and Health Management	
CE 597	Construction Engineering Management	
CE 600	Sustainable Construction	
CE 790	Special Topics in (Area) [4]	
CE 791	Individual Studies (In Area) [4]	
CECM 669	Advanced Project Management	
CECM 670	Construction Estimating and Bidding	
CECM 671	Construction Liability & Contracts	
CECM 672	Construction Methods and Equipment	
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 688	Construction Management and Leadership Challenges in the Global Environment	
CECM 689	Building Information Modeling (BIM) Techniques [3]	
Structural Engineering Courses [2]		
CE 516	Mechanical Vibrations	
CE 520	Advanced Mechanics	
CE 526	Foundation Engineering	
CE 544	Civil Engineering Analysis II	
CE 553	Design of Wood Structures	
CE 554	Design of Masonry Structures	
CE 556	Prestressed Concrete Design	
CE 557	Concrete Technology	
CE 560	Structural Mechanics	
CE 561	Introduction to the Finite Element Method	
CE 562	Advanced Structural Analysis	
CE 564	Structural Dynamics	
CE 568	Bridge Engineering	
CE 612	Theory of Elasticity	
CE 617	Theory of Plates and Shells	
CE 650	Advanced Structural Steel	
CE 655	Advanced Reinforced Concrete	
CE 712	Theory of Elasticity	
CE 715	Theory of Elastic Stability	
CE 717	Theory of Plates and Shells	
CE 750	Advanced Structural Steel	
CE 755	Advanced Reinforced Concrete	
CE 790	Special Topics in (Area) [4]	
CE 791	Individual Studies (In Area) [4]	
CESC 602	Introduction to Sustainable Smart Cities [5]	
CESC 608	Green Infrastructure and Transportation [5]	
CESC 614	Smart Cities Technologies [5]	
Environmental Engineering Courses [2]		
CE 530	Water Supply/Drainage Design	
CE 531	Energy Resources	
CE 533	Solid and Hazardous Wastes Management	
CE 534	Air Quality Modeling and Monitoring	
CE 537	Environmental Experimental Design and Field Sampling	
CE 580	Introduction to Water and Wastewater Treatment	
CE 585	Engineering Hydrology	
CE 600	Sustainable Construction	
CE 608	Green Building Design	
CE 610	The Engineered Environment	
CE 636	Stormwater Pollution Management	
CE 640	Wastewater Treatment Engineering	
CE 731	Environmental Law	
CE 732	Industrial Waste and Wastewater Treatment	
CE 736	Stormwater Pollution Management	
CE 738	Water and Wastewater Chemistry	
CE 739	Sediment Sources and Controls	
CE 740	Wastewater Treatment Engineering	
CE 781	Environmental Chemistry	

CE 782	Water Treatment Engineering
CE 783	Water and Wastewater Treatment Processes Lab
CE 786	Engineering Hydrogeology
CE 787	Stormwater Detention Pond Design
CE 790	Special Topics in (Area) [4]
CE 791	Individual Studies (In Area) [4]
CESC 600	Principles of Sustainable Development
CESC 602	Introduction to Sustainable Smart Cities
CESC 608	Green Infrastructure and Transportation
Transportation Engineering Courses [2]	
CE 543	Pavement Design & Construction
CE 621	Transportation Engineering Seminar
CE 622	Traffic Flow Theory
CE 624	Simulation Models for Transportation Applications
CE 625	Intelligent Transportation Systems
CE 646	Traffic Engineering Operations
CE 648	Urban and Transportation Planning
CE 721	Transportation Engineering Seminar
CE 722	Traffic Flow Theory
CE 723	Non-Motorized Transportation Design and Planning
CE 724	Simulation Models for Transportation Applications
CE 725	Intelligent Transportation Systems
CE 790	Special Topics in (Area) [4]
CE 791	Individual Studies (In Area) [4]

1 Minimum 24 hours of dissertation research taken over the course of at least two semesters following admission to candidacy

2 MEng courses (i.e., CECM, CESC, CESE) can be applied toward PhD degree requirements

3 Only one of these courses can be applied to the degree

4 Or any CE 690/790 IITS course offerings from UAH, USA, and/or UA campuses with prior approval of Program Director

5 Only one of these courses can be applied to the degree

Admission Requirements

The coordinated Public Health/Civil Engineering degree program is offered through the UAB School of Engineering (SOE) and the School of Public Health (SOPH). Earning these two advanced degrees provides students with a foundation for positions in research, government, as well as private industry. Students in this coordinated program earn a Doctor of Philosophy in Civil Engineering (PhD). The PhD program is intended for students who have achieved high levels of scholarship and are capable of conducting independent and original research. PhD students in civil engineering will work closely with faculty in the Department of Civil, Construction and Environmental Engineering, but they may also work on interdisciplinary teams with faculty from other UAB departments as well as outside industry. The program offers a broad curriculum covering engineering designs, resilient and sustainable urban development, low carbon and renewable energy systems, green infrastructure, natural resource management, health and livability, transport and mobility, big data analytics, and smart technologies. In addition to the PhD, students earn a Master of Public Health (MPH) with a concentration in Population Health. In this concentration, students gain a solid foundation in public health through completion of the MPH core (based on the Evidence-based Public Health framework), an Applied Practice Experience (Internship), and an Integrative Learning Experience (Capstone). Students also complete environmental health sciences courses focusing on urban health issues including air and water pollution, occupational safety, and assessing and managing environmental risks.

Graduates of this coordinated degree program will conduct research in and create solutions for human habitats that are safe, clean, and sustainable addressing issues such as the growing stressors of energy security, population growth and health, food supply, waste disposal, climate change, and future infrastructure demands.

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

1. An undergraduate engineering degree from an ABET accredited program or a master's degree in engineering. 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 or master's 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 or graduate courses in addition to the regular requirements of the MSCE degree. This set of extra requirements will be specified in writing at the time of admission to the program.

2. An undergraduate GPA of 3.0 or higher on a 4.0 scale in all undergraduate degree major courses attempted. Individuals not meeting this requirement but who have a strong professional background and excellent references may be admitted.;

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

4. **No GRE required.**

5. International students are required to have a bachelor's or master's degree in engineering or a science related field and must submit TOEFL, IELTS, PTEA, IELA, or Duolingo scores. (https://www.uab.edu/graduate/admissions/international-applicants#english-proficiency-exams). Duolingo scores are preferred by the UAB Graduate School.

6. Verification of registration by examination as a Professional Engineer (P.E.) will satisfy criterion 2 above.

Doctor of Philosophy in Civil Engineering and Master of Public Health with a concentration in Population Health

Two curricula have been developed for this coordinated program, one for students entering with a Master's of Science in Civil Engineering (MSCE) or closely related field and another for students entering without an MSCE, most likely with on a baccalaureate degree in Civil Engineering or closely-related field. The curriculum planning grid and a breakdown of coursework by degree program is attached for both options are attached. For students entering with an MSCE degree, a total of 81-83 credit hours of coursework are required for the coordinated PhD/MPH Normally, 42-44 credit hours are required for the MPH; however, because of the coordinated nature of the degree 12 credit hours from the PhD curriculum are credited to the MPH This allows students to earn both degrees in reduced time and at reduced cost. The PhD program 27 credit hours of coursework beyond the master's degree, plus a minimum of 24 credit hours of dissertation research. For students entering without an MSCE degree, a total of 90-92 credit hours of coursework are required for the coordinated PhD/MPH Normally, 42-44 credit hours are required for the MPH; however, because of the coordinated nature of the degree 12 credit hours from the PhD curriculum are credited to the MPH Twelve

credit hours from the MPH degree are used to meet PhD program requirements. This allows students to earn both degrees in reduced time and at reduced cost. The PhD program requires 48 credit hours of coursework beyond the master's degree, plus a minimum of 24 credit hours of dissertation research. Students may complete the MPH portion of this coordinated degree program totally online, in class or through a mix of online and in-class experiences. Online students pay less than the out-of-state tuition rate for the MPH portion of this coordinated degree.

Curriculum for students entering with an acceptable bachelor's degree

Requirements		Hours
MPH Core Requirements		14
PUH 601	This is Public Health	
PUH 602	Community Assessment	
PUH 603	Quantitative Methods in Public Health	
PUH 604	Programs and Policies	
PUH 605	Public Health Management and Evaluation	
PUH 606	Leadership for Evidence-Based Public Health	
MPH Degree Requirement		1
ENH 690	Environmental Health Perspectives	
Population Health Degree Requirement		3
PUH 610	Population Health	
Environmental Health Sciences Recommended Courses [1]		7
ENH 600	Fundamentals of Environmental Health Science	
ENH 612	Assessing & Managing Environmental Risks	
ENH 660	Fundamentals of Air and Water Pollution	
MPH Applied Practice Experience		3
PUH 688	Public Health Internship	
MPH Integrative Learning Experience		2
ENH 689	Environmental Health Sciences Integrative Learning Experience	
Total Unique SOPH Hours: minimum 30 required [2]		
Shared Hours from PhD in Civil Engineering		12
CE 530	Water Supply/Drainage Design	
CE 580	Introduction to Water and Wastewater Treatment	
CE 608	Green Building Design	
CE 685	Engineering Hydrology	
CE 608	Green Building Design	
CE 685	Engineering Hydrology	
Total Hours Earned for MPH Degree: 42 hours [3]		
Remaining Hours from PhD in Civil Engineering Program Requirements [4]		
CE 740	Wastewater Treatment Engineering	
CE 786	Engineering Hydrogeology	
CE 787	Stormwater Detention Pond Design	
GRD 717	Principles of Scientific Integrity	
CE 799	Dissertation Research [5]	
CE Electives		12
Total Hours Earned for PhD in Civil Engineering: 72 Hours [5]		
Total Hours Completed for PhD in Civil Engineering/MPH Degree		

1. Student may substitute ENH courses to meet their educational objectives with consent of advisor (7 credit hours minimum required)
2. Meets UAB Graduate School requirements of a minimum 30 hours of graduate work
3. Meets the CEPH MPH requirements of a minimum of 42 semester hours
4. Course substitutions may be made with consent of advisor; Assumes the recommended Environmental Health Sciences courses plus PUH 610 Population Health (12 credit hours); A minimum of 72 total credit hours are required, 48 hours of coursework and 24 hours of dissertation research
5. A minimum of 24 credit hours, taken over at least 2 terms, are required

Curriculum for students entering with an acceptable Master's degree

Requirements		Hours
MPH Core Requirements		14
PUH 601	This is Public Health	
PUH 602	Community Assessment	
PUH 603	Quantitative Methods in Public Health	
PUH 604	Programs and Policies	
PUH 605	Public Health Management and Evaluation	
PUH 606	Leadership for Evidence-Based Public Health	
MPH Degree Requirement		1
ENH 690	Environmental Health Perspectives	
Population Health Degree Requirement		3
PUH 610	Population Health	
Environmental Health Sciences Recommended Courses [1]		7
ENH 600	Fundamentals of Environmental Health Science	
ENH 612	Assessing & Managing Environmental Risks	
ENH 660	Fundamentals of Air and Water Pollution	
MPH Applied Practice Experience		3
PUH 688	Public Health Internship	
MPH Integrative Learning Experience		2
ENH 689	Environmental Health Sciences Integrative Learning Experience	
Total Unique SOPH Hours: minimum 30 required [2]		
Shared Hours from PhD in Civil Engineering		12
CE 530	Water Supply/Drainage Design	
CE 580	Introduction to Water and Wastewater Treatment	
CE 608	Green Building Design	
CE 685	Engineering Hydrology	
Total Hours Earned for MPH Degree: 42 hours [3]		
Remaining Hours from PhD in Civil Engineering Program Requirements [4, 6]		
CE 740	Wastewater Treatment Engineering	
CE 786	Engineering Hydrogeology	
CE 787	Stormwater Detention Pond Design	
GRD 717	Principles of Scientific Integrity	
CE 799	Dissertation Research [5]	
CE Electives		3
Total Hours Earned for PhD in Civil Engineering: 72 Hours [6]		
Total Hours Completed for PhD in Civil Engineering/MPH Degree		

1. Student may substitute ENH courses to meet their educational objectives with consent of advisor (7 credit hours minimum required)
2. Meets UAB Graduate School requirements of a minimum 30 hours of graduate work
3. Meets the CEPH MPH requirements of a minimum of 42 semester hours
4. Course substitutions may be made with consent of advisor
5. A minimum of 24 credit hours, taken over at least 2 terms, are required

[6] Assumes the recommended Environmental Health Sciences courses plus PUH 610 Population Health (12 credit hours); A minimum of 72 total credit hours are required, 48 hours of coursework and 24 hours of dissertation research

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 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 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 530L. Water Supply/Drainage Design Laboratory. 0 Hours.
The laboratory exercises are designed to assist the student in the investigation of water supply and drainage design including the analysis of water networks, pipe network design, storm-water and sewer collection network design, flow path visualization, hydraulic jump, flow over weirs, channel design, and basin modeling. Companion lab to CE 530 and must be taken concurrently.

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.

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

CE 542. Highway Materials and Construction. 3 Hours.
Properties of materials used in highway construction. Construction methods and management.

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 545. Engineering the Built Environment. 3 Hours.
This service learning course explores the effects the built environment has on urban function, connectivity, community health, and the well-being of its residents. Students work directly in Birmingham neighborhoods learning how to assess different components of the built environment, including transportation, green spaces, lighting, and blight, and to estimate their impacts on community health and well-being. Students then work with representatives from the city, neighborhoods, and local industry to propose engineering solutions, develop realistic cost estimates, assess potential benefits, and develop implementation plans.

CE 546. Green Infrastructure and Transportation. 3 Hours.
This 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.

CE 547. Principles of Sustainable Development. 3 Hours.
The course presents the concepts, viewpoints and fundamentals essential for understanding the urban sustainable development agenda. Students 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, students will possess the knowledge base needed to help advance sustainable smart cities development.

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 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 concordance and linear transformation for indeterminate prestressed structures.

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 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.

CE 564. Structural Dynamics. 3 Hours.
Closed form and numerical solutions to single-degree-of-freedom structural models. Analysis of multistory frames. Computer application and seismic analysis. Techniques of modal analysis.

CE 565. CE Construction Documents. 3 Hours.
Introduction to Civil Engineering design and construction documents including drawings, specifications, contracts, and testing reports. Overview of civil infrastructure and project types, including the civil engineer's role in the preparation, certification, and use of construction documents. Construction topics include measurement, quantity estimating, and engineering budgets.

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 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 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 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 597. Construction Engineering Management. 3 Hours.
Study of construction management services that include: project planning, scheduling, estimating, budgeting, contract administration, agreements, and ethics. Emphasis is made on the management of manpower, materials, money and machinery.

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 recourse 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. Airy 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 617. Theory of Plates and Shells. 3 Hours.
Linear theory and solutions of plates and various shapes. Large deflection theory and solutions of rectangular and circular plates. Membrane and bending theories of shells. Solutions of problems in conical, cylindrical, and spherical shell.

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 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 625. Intelligent Transportation Systems. 3 Hours.
Legal, institutional and planning issues related to intelligent transportation systems. System architecture, communication techniques, advanced user services, intermodal systems, connected and autonomous vehicles applications.

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.
Aquatic chemistry. Chemical behavior of pollutants in receiving waters. Fate of common pollutants. Chemical kinetics in natural waters. Photochemical reactions. Modeling of wastewater discharges.

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 643. Pavement Design and Construction. 3 Hours.
Design and construction of flexible and rigid pavements. Topics include stress and strain responses, design parameters, AASHTO and NAPA design procedures, pavement construction, pavement rehabilitation, and maintenance techniques.

CE 646. Traffic Engineering Operations. 3 Hours.
Highway and intersection capacity analysis, traffic signal timing and phasing, signal coordination, freeway operations, non-signalized traffic control techniques.

CE 648. Urban and Transportation Planning. 3 Hours.
Land use planning for transportation systems; trip generation, trip distribution, modal split, and traffic assignment.

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

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.

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 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. 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.

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 Civil, Construction, and Environmental Engineering. 3-9 Hours.
Research tools, including elements of experimental design and proposal preparation. Effective communication, literature searches, and exploratory data analysis.

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.

CE 698. Non-Thesis Research. 1-12 Hour.

CE 699. Thesis Research. 1-12 Hour.
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.
Static stability of bars, beams, trusses, and rigid frames. Dynamic stability of bars. Energy method applied to buckling problems. General theory of elastic stability.

CE 717. Theory of Plates and Shells. 3 Hours.
Linear theory and solutions of plates of various shapes. Large deflection theory and solutions of rectangular and circular plates. Membrane and bending theories of shells. Solutions of problems in conical, cylindrical, and spherical shell.

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, communication techniques, advanced user services, intermodal systems, connected and autonomous vehicles applications.

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.
Aquatic chemistry. Chemical behavior of pollutants in receiving waters. Fate of common pollutants. Chemical kinetics in natural waters. Photochemical reactions. Modeling of wastewater discharges.

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 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 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.
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 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 Engineering. 3 Hours.
Research tools, including elements of experimental design and proposal preparation. Effective communication, literature searches, and exploratory data analysis.

CE 797. Civil, Construction, and Environmental Engineering Internship. 6 Hours.
Off-campus internship experience working with industries, utilities, or government agencies. Students taking this course will not be allowed to apply Special Topics or Individual Studies courses toward degree requirements.

CE 798. Non-Dissertation Research. 1-12 Hour.

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.

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 importance of building codes is presented in the course material. 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.
The course addresses the key concepts, viewpoints and fundamentals essential for understanding green building and construction. Materials are 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). 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.

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 688. 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. 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.

CECM 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 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 Livability. 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 livability, and understand the increasingly important role of Information and Communications Technology (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.
This course gives students the opportunity to study emerging smart technologies that can be deployed and integrated together with the aim of improving overall building / city performance. The course provides an overview of technologies that can be used to: sense and measure physical parameters; acquire, process, and analyze various datasets; and make appropriate decisions / gives suitable instructions based on all available information. Specific technologies addressed include Data Acquisition, Telecommunications, Wireless Sensor Networks, and the Internet of Things. The course will also explore and evaluate how these emerging technologies can contribute to various smart cities / buildings priorities, namely Energy Management, Health, Safety, and Security.

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 livability. 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 653. 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.

CESE 656. 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.