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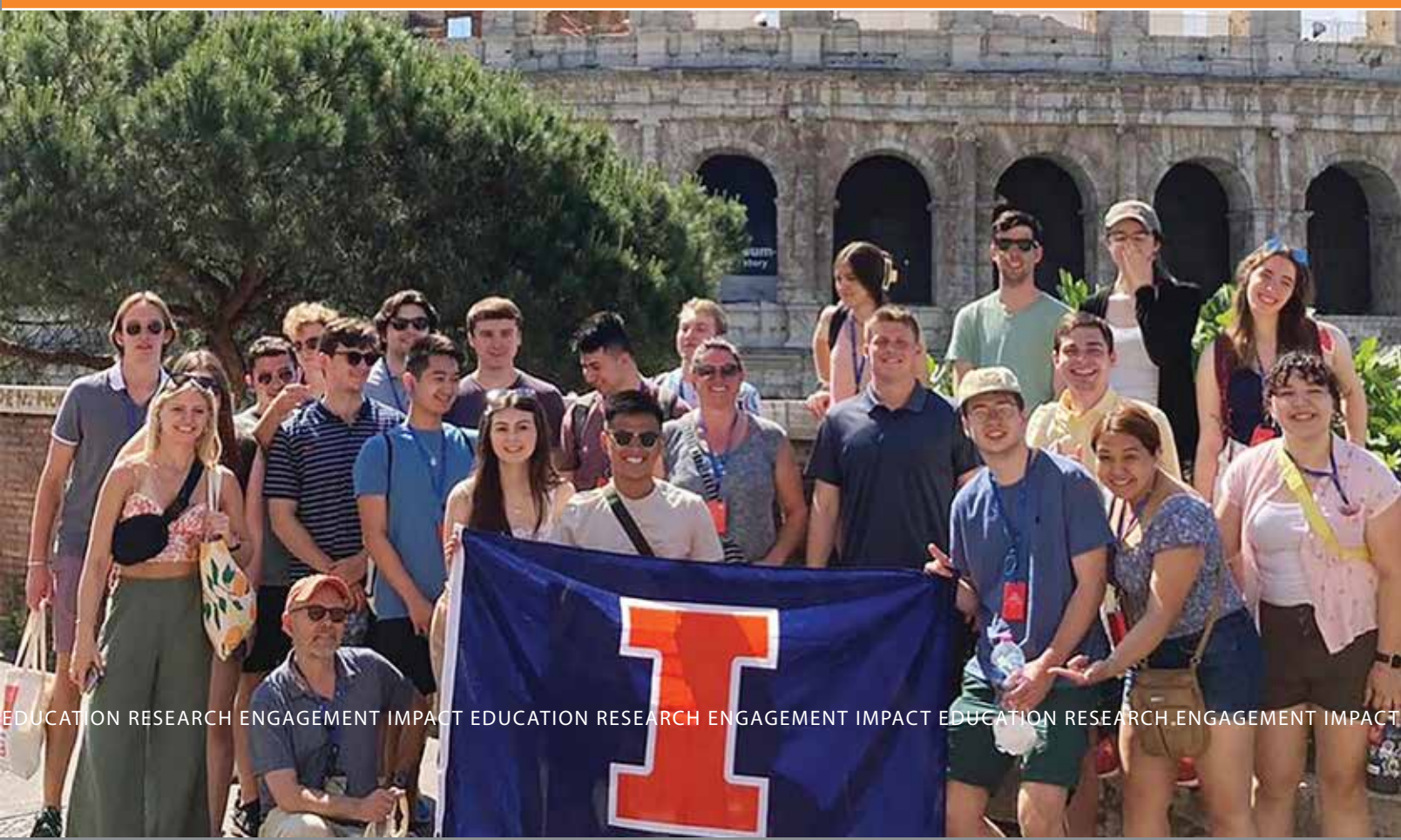
Civil and Environmental Engineering Graduate Handbook 2023-2024

THE GRAINGER COLLEGE OF ENGINEERING



UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

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This publication is available in an accessible electronic format at (cee.illinois.edu/academics/graduate-programs/graduate-handbook).

Civil and Environmental Engineering at the University of Illinois at Urbana-Champaign

The University of Illinois at Urbana-Champaign was founded March 2, l868, under the Land Grant College Act signed by Abraham Lincoln. In 1870, the College of Engineering was established. In 1871, the Department of Civil Engineering was organized; and in 1872, four civil engineers were graduated. Now, over 150 years since our organization, the Department of Civil and Environmental Engineering (CEE) at the University of Illinois at Urbana-Champaign is one of the largest, most comprehensive, and most highly ranked departments of Civil and Environmental Engineering in the country with approximately 700 undergraduates, 650 graduate students and a faculty of 64. The University of Illinois at Urbana-Champaign is a large research university, and our Civil and Environmental Engineering Department performs over $20,000,000 of research annually. The department offers graduate studies in eleven tracks or areas of specialization (listed below) as well as joint master's programs.

Construction Engineering and Management

Construction Materials

Engineering Materials and Additive Manufacturing Technologies

Energy-Water-Environment Sustainability

Environmental Engineering

Geotechnical Engineering

Societal Risk and Hazard Mitigation

Structural Engineering

Sustainable and Resilient Infrastructure Systems

Transportation Engineering

Water Resources Engineering and Science

Information Available on the Internet

Campus Locator Map	http://map.illinois.edu/view
CEE Graduate Student Blog	cee.illinois.edu/academics/graduate-programs/graduate-blog
Civil and Environmental Engineering Department	cee.illinois.edu/
Counseling Center	https://counselingcenter.illinois.edu/
Courses, Schedules, and Requirements	courses.illinois.edu/resources
Graduate College Diversity, Equity & Inclusion Office	grad.illinois.edu/prospective/underrepresented
Fellowship Information	grad.illinois.edu/fellowships
Financial Assistance	grad.illinois.edu/prospective/financial
Forms Used for Graduate Students	https://grad.illinois.edu/forms/
Graduate Assistantship Clearinghouse	https://grad.illinois.edu/clearinghouse/
Graduate College	grad.illinois.edu/
Graduate College Academic Calendar	https://registrar.illinois.edu/academic-calendars/
Graduate College Handbook	grad.illinois.edu/gradhandbook
Housing	https://www.housing.illinois.edu/
International Student and Scholar Services (ISSS)	isss.illinois.edu/
Registration Checklist	registrar.illinois.edu/registration-checklist
Student Health Insurance	http://si.illinois.edu/
Student Rights and Responsibilities	studentcode.illinois.edu/
Tuition and Fee Rates	https://registrar.illinois.edu/tuition-fees/tuition-fee-rates/
University Student Financial Services & Cashier Operations	https://paymybill.uillinois.edu/
Well-Being	https://grad.illinois.edu/gradmap/well-being

Frequently Asked Questions

How do I receive information from the department?	Important announcements are posted on the Grad Blog. Check the Grad Blog (cee.illinois.edu/academics/graduate-programs/graduate-blog) frequently! If you still have questions, ask Joan Christian in 1108 Newmark Lab (NCEL).
Who is my advisor?	If you haven't made some prior arrangement with a professor, the department will assign you an advisor. If you can't determine who that is, check with Joan Christian in 1108 NCEL or Katya Trubitsyna in 1104 NCEL.
Why do I need to see an advisor?	New and continuing students should select courses in consultation with their advisor to avoid courses which could lead to delays in the student's academic progress.
When are NCEL and CEEB (Hydrosystem Lab) buildings open?	The building is open 7 a.m. - 5 p.m. Monday through Friday. Key card access is required after 5pm.
How do I obtain a building key?	All registered CEE students will have key card access after 5pm with their I-Cards.
Can I have a desk?	Office space and desks are provided for all that have fellowships and research assistantships. The department cannot provide desks to graduate students who do not have such appointments. Check with your advisor.
Is there a student lounge?	Student lounge areas are located on each floor of the Yeh Center and CEEB (Hydrosystems Lab) as well as in the NCEL basement.
When can I meet with Joan Christian to discuss questions I have about my graduate program?	Joan's 'walk-in' office hours are: Monday-Friday 10 a.m.-12 p.m. 1 p.m. – 4 p.m.
If I am a coursework only M.S. student, can I apply to the Ph.D. program?	Yes. Existing M.S. students who would like to be considered for the Ph.D. program, but have not identified a research advisor, should submit a new graduate student application by the regular deadlines for applicants wanting to be considered for financial aid (e.g., by January 1st for fall applicants).

Departmental Resources and Key People

Service	Resource Person	Office	Telephone (area code 217)	Email
Academic Records	Joan Christian	1108 NCEL	265-4496	jchristn@illinois.edu
Admissions	Katya Trubitsyna	1104 NCEL	300-0194	katia@illinois.edu
Employment Records/Human Resources	David Hartzell	1111 NCEL	300-8655	dsh@illinois.edu
Director of Graduate Studies	Scott Olson	1110 NCEL	265-7584	olsons@illinois.edu
Building Facilities	Jamar Brown	1135 NCEL	300-1721	jmrbrown@illinois.edu
Thesis Format Checker	Joan Christian	1108 NCEL	265-4496	jchristn@illinois.edu
Graduate Student Advisory Committee	Gus Greenwood			tgg3@illinois.edu
CEE Online	Meg Griffin		333-3921	mgriffn@illinois.edu
MS and 3+2 Program Advising	Meg Griffin		333-3921	mgriffn@illinois.edu

Area Graduate Admissions Coordinators

(for information on area policies, courses, QE procedures, etc.)

Area	Faculty Member	Email address
Construction Management	Khaled El-Rayes	elrayes@illinois.edu
Construction Materials	John Popovics	johnpop@illinois.edu
EMMA^T	Oscar Lopez-Pamies	pamies@illinois.edu
Environmental Engineering	Chris Tessum	ctessum@illinoise.edu
EWES	Art Schmidt	aschmidt@illinois.edu
Geotechnical Engineering	Roman Makhnenko	romanmax@illinois.edu
Structural Engineering	Eun Jeong Cha	ejcha@illinois.edu
SRIS	Nishant Garg	nishantg@illinois.edu
SRHM	Frank Lombardo	lombaf@illinois.edu
Transportation Engineering	J. Riley Edwards	jedward2@illinois.edu
Water Resources Engineering	Art Schmidt	aschmidt@illinois.edu

Professional Conduct and Academic Integrity

Responsible professional conduct and academic integrity are essential for maintaining the high quality of education and research in the department. Faculty and graduate students must conduct themselves in a professional and collegial manner in all dealings with each other. Graduate students holding teaching assistant (TA) or research assistant (RA) appointments should work together with their supervisors to develop a plan, based on reasonable expectations of student productivity, to involve an amount of effort commensurate with the percentage time of the appointment. For further useful information, consult the campus' official statement on *Responsible Professional Conduct: Guidelines for Teaching, Research, and Service*, available at http://research.illinois.edu/regulatory-compliance-safety

The faculty of the Department of Civil and Environmental Engineering expects all students to always maintain academic integrity in the classroom and the research laboratory and to conduct their work in accordance with the highest ethical standards of the engineering profession. The basic campus policies and definitions regarding academic integrity in course work are presented in the *Student Code*, Article1, Part 4.(https://studentcode.illinois.edu/article1/).

All members of the university community are expected to adhere to the highest standards of academic integrity and ethical behavior in research and publications. The official university statement is online at https:// research.illinois.edu/. Further definitions and information are provided in the *Graduate College Handbook for Students, Faculty and Staff* (http://www.grad.illinois.edu/gradhandbook/).

Additional helpful information about academic integrity and plagiarism is at http://www.library.illinois.edu/ask-us/information-for-researchers/. It is expected that all graduate students in the department will read and understand these campus policies.

To further foster and promote integrity among students, the CEE Honor Code was developed. The honor code is a written pledge. Instructors are requested to put the CEE Honor Code in the syllabi of all CEE courses, and on the cover page of every CEE exam. Students commit to the honor code each time they sign an exam, and implicitly whenever they put their signature on a class assignment.

The CEE Honor Code is the following:

I pledge to uphold the highest levels of professional and personal integrity in all of my actions, including: 1) never assisting or receiving unfair assistance during exams, 2) never assisting or receiving assistance on class assignments beyond that specified by an instructor, and 3) always fully contributing to group activities that are part of a course activity.

Registration and Programs of Study

Registration. Important dates and deadlines are announced in the Graduate College Calendar (https://grad.illinois.edu/general/calendar/fall. Registration is carried out using the University of Illinois at Urbana-Champaign Enterprise Applications - Student Self-Service registration system (apps.uillinois.edu/selfservice/index.html). Fall semester instruction begins in late August and the semester terminates in mid-December. Spring semester instruction begins in the third week of January and the semester terminates in early May. Summer sessions generally extend from approximately May 15th through August 5th. CEE classroom instruction normally occurs during the 8-week summer session II which begins around mid-June.

Advisors. All graduate students are assigned an academic advisor who assists in planning and carrying through a program of graduate coursework which fits their needs and satisfies departmental and Graduate College requirements.

Course Credit. Graduate credit is measured in terms of hours. The normal program for a full-time graduate student is 12 hours each fall and spring semester. The normal program for an eight-week summer session is 4 hours, with 10 hours being the maximum permitted. The amount of credit which may be earned in individual courses is indicated in the course listing provided later in this document. Please refer to the course information for details. For more information about course loads, please see the *Graduate College Handbook for Students, Faculty, and Staff,* Chapter 2.2: page 15 https://grad.illinois.edu/files/pdfs/handbook.pdf

Students must take a minimum of 6 CEE courses (24 credits) to receive a M.S. degree in CEE. Exceptions to this policy may be petitioned by the student and academic advisor to the Director of Graduate Studies.

Transferring Enrollment and/or Course Credit to Other Departments. Students wishing to enroll/transfer to another department (within or outside of the College of Engineering) will need to petition that department/college for entry (see Petitions section above). Enrollment requirements are set by the individual departments/colleges. Students should be aware that CEE course credit may not be accepted by other departments toward the completion of a graduate degree. While CEE students commonly enroll in relevant courses outside of CEE, students must meet the credit and course requirements described in later sections to earn a MSCE, MSEE, or PhD in Civil and Environmental Engineering. In general, CEE will not approve petitions to transfer enrollment or CEE course credit to other departments if the majority of the student's credits have been earned outside of CEE.

CEE 597 Independent Study. To help minimize problems associated with execution of an independent study, each student must submit an *Independent Study Application/Approval form.* This form includes a description of the independent study and requires the signature of the instructor, the student's advisor, and a department officer (generally the associate head of the department). The form can be obtained at 1108 NCEL Forms and Resources | Civil & Environmental Engineering | UIUC (illinois.edu). No more than 8 hours of CEE 597 credit can be counted toward either the M.S. or the Ph.D. program.

Work Completed Elsewhere. A student who has completed graduate work at an accredited institution within the past five years with a grade of A or B may petition that the credits be applied toward the M.S. degree at the University of Illinois at Urbana-Champaign. Supporting information must be supplied, including transcripts of the work in question and validation by faculty in the specialization area of the course stating the course work is both applicable and of an appropriate level of difficulty. Generally, a maximum of 12 semester hours of transfer credit may be counted toward the M.S. degree. Upon recommendation of the Department, the Graduate College may permit a student to register in absentia for work at a laboratory elsewhere that offers facilities not available in the Urbana-Champaign area. Such work is accepted for graduate credit if it is completed satisfactorily. Credit from

outside the Graduate College may not be transferred to count toward Stage II or Stage III of a doctoral program. Chapter 3.3: page 28 https://grad.illinois.edu/files/pdfs/handbook.pdf.

Minors. Students who wish to add a minor degree to their major degree program may apply **up to** 12 hours of credits taken for the minor to the major degree program. The courses will need to be approved by the student's CEE advisor and the Director of Graduate Studies beforehand. Students will have to complete a graduate student petition to transfer the credit to the major degree program.

Miscellaneous Courses. A student carrying a normal graduate program may elect one additional miscellaneous course (a course which does not give credit toward an advanced degree). If a graduate student enrolls for more than one miscellaneous course, he or she may not register for a full graduate program. Courses intended to teach graduate students a reading knowledge of French, German, or Russian are regarded as miscellaneous courses. A student who elects a miscellaneous course is required to register for that course and complete the assigned work. Any undergraduate course taken for credit (A-F) will count toward the GPA, but not toward the graduate credit requirements.

Auditing Privileges. A graduate student may, with the instructor's permission, attend as an auditor, provided a *Visitor's Permit* bearing the approval of the instructor and the dean of the college offering the course is filed with the Records Section of the Office of Admissions and Records by the 10th day of class; a $15 fee is required. The *Visitor's (Auditing) Permit* can be found at http://www.grad.illinois.edu/forms. Auditing is not permitted for laboratory courses. The student may not take the same course later for credit. A student may "sit in" rather than officially audit a class if the instructor approves such an arrangement. Having audited a course will appear on the student's transcript, but simply "sitting in" will not. A student auditing a course is expected to attend the lectures. If the student is not able or willing to attend lectures, then the instructor can request the student remove the course audit with a petition. The student should file the petition to remove the course audit before the end of the semester.

Full-Time Course of Study for Graduate Students. Graduate students may be required to maintain full-time enrollment for several reasons. Many academic programs require registered students to maintain a full-time load. Full-time status may be required for certification related to student loans, fellowship and traineeship appointments, and certain types of non-university medical insurance policies. International students may be required to maintain full-time status for purposes of *Student Exchange and Visitor Information System* (SEVIS) reporting.

As of Fall 2021, all students in The Grainger College of Engineering must register for **at least 9 credit hours (including CEE599)**, *or the minimum number of hours required by University policy** if this is greater than 9 hours, during each fall and spring semester of enrollment to be considered as full-time students in CEE. Students wishing to register for fewer credit hours in an individual semester than this required minimum must meet one of the requirements below and receive permission for this from the CEE Graduate Program office.**

*Per the Student Code (§3-301), registration in at least 12 credit hours in a semester is required for certification as a full-time graduate student, unless the student holds a 25-67% assistantship appointment. This also applies for purposes of maintaining an international student's visa status.

**Permission to register for fewer than 9 credit hours in an individual semester may be granted in the following circumstances:

- Students enrolled in an online degree program;
- Students holding significant employment outside the University, including an internship;
- Students in coursework-only master's programs in their last semester of study who have fewer than 9 credit hours left to complete their degree requirements; and
- Students experiencing a documented medical reason.

For graduate students with 25%-67% research assistantships, teaching assistantships, or fellowships:

- Fall and spring terms: a minimum of 9 graduate hours; individual programs may set higher requirements.
- Summer term: a minimum of 4 graduate hours of thesis credit or a course that meets for at least eight weeks (enrollment in a four-week course in the summer term will not fulfill the requirement for full-time registration).

For graduate students with 1%-24% assistantships and graduate students without assistantships:

- Fall and spring terms: a minimum of 12 graduate hours.
- Summer term: a minimum of 6 graduate hours in thesis credit or a course that meets for at least eight weeks (enrollment in a four-week course in the summer term will not fulfill the requirement for full-time registration).

For more information about credit loads, please see the *Graduate College Policies and Procedures* webpage, Chapter 2.2: page 15 https://grad.illinois.edu/files/pdfs/handbook.pdf.

Programs of Study. Students' courses and research are planned with their advisors. Consideration is given to previous academic training, career objectives, and the general requirements of the Graduate College and the Department of Civil and Environmental Engineering. The student should become familiar with these requirements and satisfy them as soon as possible.

Graduate Study in the Summer. A limited number of Civil and Environmental Engineering graduate courses are offered during Summer session II. The graduate courses offered vary from summer to summer. It is *not* possible to obtain a M.S. or doctoral degree in Civil and Environmental Engineering by attending only summer session classes.

The number of hours of M.S. and Ph.D. thesis enrollment is one of the major sources of information used to assess the contribution of faculty and departments to the graduate research mission of the campus. Therefore, if a faculty member and a graduate student are engaged in thesis-related research in the summer, it is expected that the faculty member and the department receive credit for this activity. For this reason, the department will require that students who are working on their M.S. or Ph.D. research and are supported by research assistantships register for a minimum of 4 hours in the summer.

This policy only applies to students with a summer research assistantship appointment of at least 25%. There may be valid circumstances when this policy can be waived and students should contact the Director of Graduate Studies with exception requests.

Grades. A minimum grade-point average (GPA) of 2.75 is required for a student to be certified by the Department and the Graduate College as eligible to receive an advanced degree. GPA is based on a system where A=4, B=3, etc. Included in the GPA computation are all hours with grades of A through F. Excluded from the computation are all semester hours with grades of Excused, Deferred, Satisfactory, Unsatisfactory, Pass, Fail, Credit-No Credit, Withdrawn, and work not completed on the Urbana-Champaign Campus. A student with a GPA of less than 2.75 will be sent a warning letter by the Graduate College with a copy to the Department. A student who has received a warning letter and who has not raised his GPA to 2.75 by the end of the next semester will not be permitted to register without the permission of the Department and the Graduate College. Students with a GPA below 2.75 are not eligible for a degree. The current Illinois grading system is available online at http://www.grad.illinois.edu/gradhandbook , Chapter 3.1, page 23.

Performance. After documented feedback and communication from their advisor, students who are still not performing satisfactorily toward their M.S or Ph.D. degree may be placed on departmental probation. The student will receive notification they are being put on departmental probation and will be given a semester to further address the issue, which may include finding another advisor.

Credit-No Credit Grading Option. With the approval of the student's advisor and the completion of a *Credit-No Credit Option* form, courses may be taken on a credit-no credit basis. In general, advanced-level courses in the student's major field must be taken for a letter grade. In any one semester, a student may take no more than 4 semester hours on a credit-no credit basis. Over the entire degree program, a student must earn at least 2 hours of graded (A-D) course work for each hour of credit-no credit course work. Students are permitted to elect this non-grade option through the last day allowed for dropping a course without academic penalty. Forms must be initiated by the student on the Graduate College Grad Student portal at: https://go.grad.illinois.edu/student-portal. A student may cancel this option by filing an amended request by the deadline date for dropping a course without academic penalty, as indicated in the Graduate College calendar. All students and advisors are cautioned, with respect to the credit-no credit option, that until other universities throughout the country adopt a similar basis, students having a large number of non-graded courses may not receive adequate consideration for national awards or fellowships or post-doctoral positions at other institutions.

Petitions. A student may petition for exceptions to various academic and administrative requirements to the Dean of the Graduate College, but should do so only after consulting with his or her advisor and with the recommendation of the Department. Graduate student petitions must be initiated by the student on the Graduate College Grad Student portal at: https://go.grad.illinois.edu/student-portal.

Grievances. Any graduate student in the Department of Civil and Environmental Engineering may informally pursue or formally file a grievance when he or she believes that a decision or behavior adversely affects his or her status as a graduate student. The grievance policy and procedures of the Department of Civil and Environmental Engineering are stated in Appendix 1. The purpose of this policy is to protect the interests of graduate students in the Department of Civil and Environmental Engineering by providing informal and formal means of seeking resolution in case of an inappropriate action of a member of the faculty or administrative staff or an inappropriate application of departmental procedures. In the Department of Civil and Environmental Engineering, the student grievance is adjudicated by the Graduate Affairs Committee, which oversees all matters relating to the graduate programs.

CEE Grad Blog. Important notices to graduate students regarding events, jobs, fellowships, teaching assistantships, research assistantships, etc. are posted on the CEE Grad Student Blog (cee.illinois.edu/academics/graduate-programs/graduate-blog). In general, we do not send individual notices by email. Check the CEE Grad Blog daily!

Annual Review of Progress. Graduate College policy requires the CEE program to conduct annual academic progress reviews of all graduate students enrolled in degree-seeking programs, including degree-seeking students in online programs.

All Ph.D. and M.S. thesis graduate students must complete an online *Self-Evaluation* form, and their advisor must complete an online faculty evaluation. The faculty evaluation requires that students meet face-to-face with their advisors for a formal annual review.

All M.S. non-thesis graduate students are required to do an online self-evaluation.

A copy of the form may be found by going to https://my.cee.illinois.edu . Log-in with your net ID and password. Click on the 'Grad Student Toolbox', then click on the "MS/PhD Self Evaluation."

The Degree of Master of Science (MSCE, MSEE)

Credit Requirements. All candidates for the degree of Master of Science in Civil Engineering (MSCE) or Master of Science in Environmental Engineering (MSEE) are required to consult their advisor. In all programs, at least 16 hours of credit must be in the student's major field. Also, 12 hours of credit must be obtained for courses numbered in the 500 series, and eight of these twelve 500-level hours must be taken for grades in the major field. No more than four of these eight hours can be CEE 597 Independent Study.

> Thesis Option: A candidate for the MSCE or MSEE degree who is required or elects to write a thesis must complete at least 32 hours of graduate work (including CEE 599 thesis credit). A typical master's program with a thesis includes 24 hours of course work and 8 hours of CEE 599 thesis credit. No more than 12 hours of CEE 599 thesis credit can be devoted to the MS thesis.
>
> No Thesis Option: A candidate for the MSCE or MSEE degree who is not required or elects not to write a thesis must complete at least 36 hours of course work. Special requirements for several areas of CEE are summarized in Appendix 2. Students wishing to pursue MSCE programs that cannot be accomplished in any of the ten areas of specialization may submit their proposed plan of study directly to the Graduate Affairs Committee for approval. See Joan Christian in 1108 NCEL for details.
>
> Online Option: A candidate for the MSCE or MSEE online option must complete 36 hours of course work. Areas and classes are limited to those offered online. See https://grainger.illinois.edu/academics/online/courses for a list of available courses.

Residency and Time Requirements. At least one-half of the minimum hours required for the MSCE or MSEE degrees must be for courses meeting on the Urbana-Champaign Campus, or in courses meeting in other locations approved by the Graduate College for residence credit. A candidate for the master's degree must complete all requirements for the degree within five calendar years after initial registration in the Graduate College.

Plan of Study. All M.S. candidates must complete a Plan of Study, which must be submitted for approval during the first semester of graduate work. A sample Plan of Study is found in Appendix 3.

Foreign Language. There is no foreign language requirement for the M.S. degree.

Thesis. Credit for thesis research (CEE 599) cannot be applied to a degree unless a thesis is submitted. The thesis must be the work of a single author. For instructions regarding the format of the thesis, the student should review the Graduate College website for *Thesis* and *Dissertation* at http://www.grad.illinois.edu/thesis-dissertation. The thesis format must be officially checked by the Department before it can be deposited. Ms. Joan Christian (jchristn@illinois.edu) is authorized to perform the departmental format check.

Switching from M.S. Thesis (32 hour) to Coursework M.S. (36 hour) Degree. M.S. students desiring to switch from M.S. thesis track to a 36-hour coursework-only M.S. degree must have their advisors written consent or they will not be allowed to switch.

Changing Areas of Specialization. M.S. candidates wishing to transfer from one departmental area of specialization to a new area must have their credentials transmitted to the new area for review. If the new area accepts the transferring student, then the student may continue and complete his or her M.S. program in the new area. See Katya Trubitsyna in 1104 NCEL for details.

Second M.S. Degree in CEE. The University of Illinois at Urbana-Champaign policy prohibits awarding second degrees in the same area of specialization. **CEE Policy:** Except under unusual circumstances, a second M.S. degree is not permitted if the student is admitted into the Ph.D. program using the first M.S. degree as fulfilling the requirements for Phase I of that program. A second M.S. degree may be permitted if the student is admitted into the CEE M.S. program because the first degree is insufficient for some reason. In any case, the course work used to earn a second (University of Illinois) M.S. degree should not duplicate the course work of the student's first M.S. degree.

Students that would like to transfer to our program to obtain an M.S. degree from another department's PhD program would need to be **registered** in our program a minimum of one semester and meet M.S. degree requirements for that area of specialization as well as meet their own department policies.

Graduation. Students are responsible for notifying the Graduate College of their intention to graduate in a given semester; that is, students are responsible for placing their names on the "degree list." Students must use the University of Illinois at Urbana-Champaign Enterprise Applications – Student Self-Service system (https://apps.uillinois.edu/selfservice/) to place their name on the graduation list by the stated deadline.

Data Science + CEE MS Track. A non-thesis Master's track in CEE that emphasizes data science can be pursued through a balance of courses in data science methodology and discipline-specific courses from a particular CEE area of study. The goal of the track is to provide students with graduate-level expertise in both data science and a technical domain in CEE. The track consists of nine courses, three of which are required core CEE courses in the area of data science. Please see Appendix 4 for more information about graduate course requirements.

Engineering Materials and Additive Manufacturing Technologies EM(MA)^{T}
A new non-thesis Master's track in CEE that capitalizes on the excitement of 3D printing offers technical courses in mechanics, experimental methods and materials, and material science. The track consists of five core CEE courses with the remaining four as technical electives selected with advisor approval. Please see Appendix 5 for more information about graduate course requirements.

CEE Online Program. The degree (MSCE or MSEE) earned through the online program is the same degree awarded on campus. Courses offered online are the same as the on-campus courses. The degree earned and transcript records do not distinguish between online and on-campus delivery. Students may request via graduate college petition to change their program code to complete a degree online, or vice versa. This request is subject to advisor, Department, and Graduate College approval.

3+2 BS/MS Program. This program allows international students to spend their senior year at the University of Illinois at Urbana-Champaign, earn a Bachelor of Science degree from a participating international university, and continue their education to earn a Master of Science degree in civil or environmental engineering from the University of Illinois in one year. Students typically spend three years at their home university and two years at Illinois to complete B.S. and M.S. degrees in five years. In the first year, they complete coursework required for their BS degree. By the beginning of the 2nd year, each MS student will select a CEE specialty area and be assigned a faculty advisor in their area of specialization. Students in the 3+2 program must maintain a 3.3 GPA, and the Structural Engineering area specialization requires a cumulative GPA of at least 3.5 for all University of Illinois courses. Students may transfer a maximum of 8 graduate-level hours from the first year at Illinois to their M.S. degree for courses not used for their B.S. degree. Visit
http://cee.illinois.edu/academics/international-programs for more information.

CEE has 3+2 agreements with the following international universities:

Abu Dhabi University
American University of Ras al-Khaimah
Beijing Jiaotong University
Central South University
Chang'an University
Chongqing University
Dalian University of Technology
Guangzhou University
Istanbul Technical University
Monterrey Institute of Technology
National Cheng Kung University
Panamerican University
Santo Domingo Institute of Technology
South China University of Technology
Southeast University
Southwest Jiaotong University
Tongji University
Tsinghua University
University of Jinan
Zhejiang University

The Degree of Doctor of Philosophy (Ph.D.)

The degree of Doctor of Philosophy, *primarily a research degree*, is offered in the fields of civil engineering and environmental engineering in civil engineering.

Residence and Credit Requirements. The doctoral program consists of three stages (see Fig. 1).

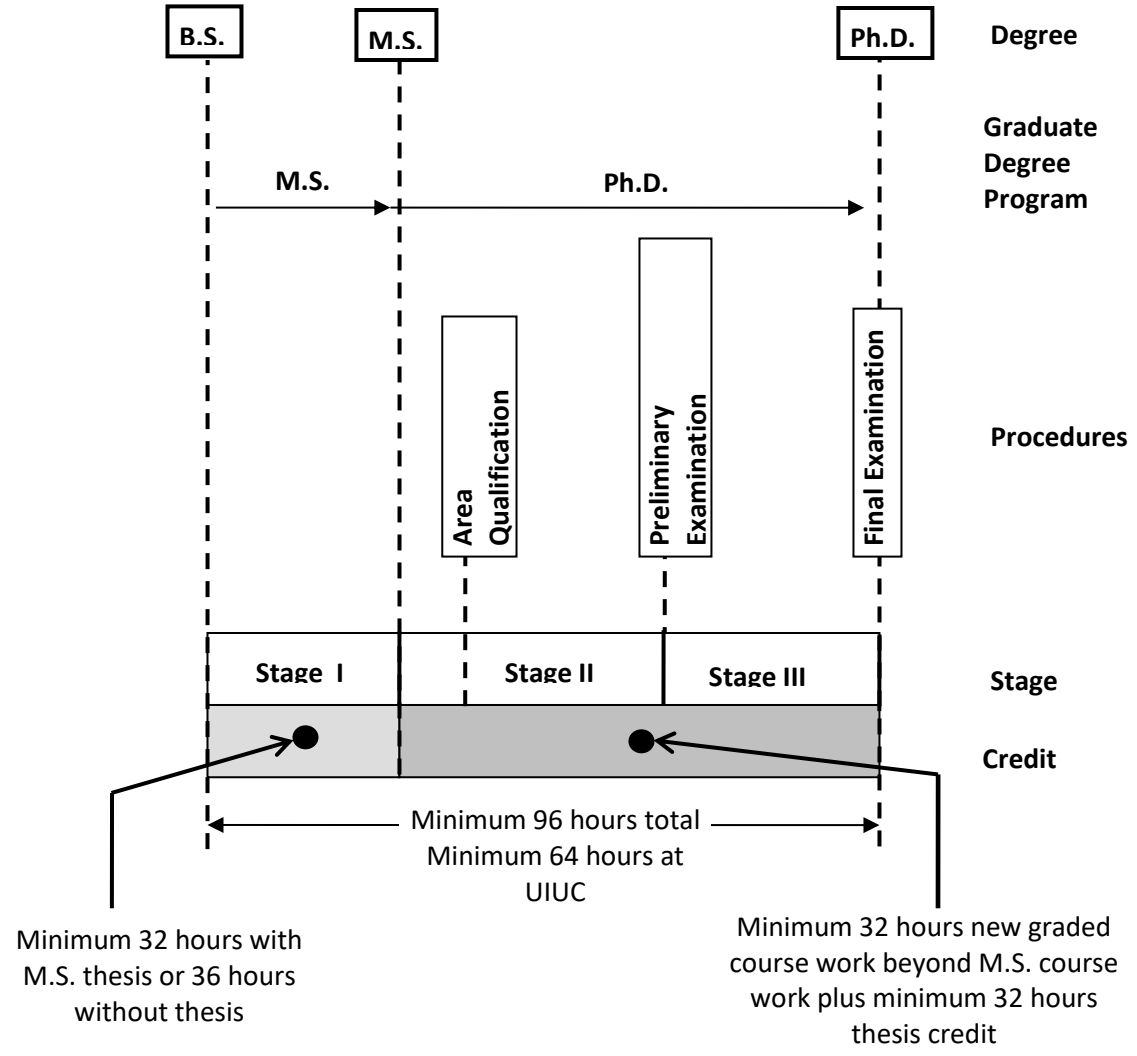

Fig. 1. ***The Three Stages of the University of Illinois at Urbana-Champaign Ph.D. Degree Program***

After the receipt of an M.S. degree (Stage I), the student is considered to be an aspirant to the Ph.D. degree program (continuation of Stage I), but is not officially admitted to the program (Stage II) until the student has satisfied the area qualification procedures; see Table 1(page 18) for a description of area qualification procedures. A minimum of 96 hours of credit are required, 64 of which must be in residence.

Stages II & III must be completed in residence

- The first stage is completed when the candidate has received a master's degree or has earned the equivalent number of credits AND has satisfied the area's qualification procedures.
- The second stage consists of completion of a minimum of *32 additional hours of graded course work,* beyond the M.S. requirements, fulfillment of departmental requirements, including language requirement, if any, and passing the preliminary examination. There may be no transferring of credits from outside Illinois during this stage.

- The third stage is primarily devoted to research with a minimum of 32 hours of thesis credit by end of stage III, preparation of the dissertation, and the final examination. Courses may be taken during this period as well. There may be no transferring of credits from outside Illinois during this stage.

During all three stages the student is expected to register for a full program, or if employed, for the normal credit allowed under the terms of the appointment. It is possible to complete these stages in three years if the student devotes full time to his or her academic program. A candidate for the Ph.D. degree must complete all requirements for this degree within seven calendar years after initial registration in the Graduate College, except as noted in the following. A candidate for the doctorate who has received a master's degree elsewhere must complete all requirements for the degree within six years after initial registration in the Graduate College. A student whose program of study is significantly interrupted after receiving a master's degree from the University of Illinois and who later returns to work for the doctorate will have six years from the date of return to complete degree requirements. Please see the *Graduate College Handbook*, Chapter 6.2, page 37 *Time Limits*, http://www.grad.illinois.edu/gradhandbook .

Milestones and Schedule for Making Progress in the Ph.D. Program. The following table lists the significant steps that a student must complete during their Ph.D. program. A time schedule is also included so that students can assess their rate of progress in the program. The maximum time limits are to ensure that students do not take an excessively long time to complete their degree. It is recognized that there are special circumstances, particularly with interdisciplinary research, which may cause students to need some additional time. "Normal Progress" would apply to a student with a fellowship or 50% research assistantship.

Milestone	**Normal Progress**	**Limit**
Select Research Advisor	End of 1st Semester	End of 2nd Semester
Qualifying Exam	2nd Semester	**4th Semester**[1]
Complete Key Coursework Required for Research	3rd – 4th Semester	4th – 5th Semester
Preliminary Exam	4th - 5th Semester	**5th Semester**[2]
Final Examination	8th Semester	6 Years[3]
Thesis Deposit	8th Semester	7 Years[3]

[1]All students must pass the Qualifying Examination within four semesters (2 years) of enrolling in the Ph.D. program.

[2]This 2.5-year limit is strictly enforced by the Department. In exceptional cases, a 6-month extension can be granted with approval from the student's advisor and the Director of Graduate Studies.

[3]See the *Graduate College Handbook* Chapter 6.2, page 37 *Time Limits*, https://grad.illinois.edu/handbooks-policies . Students earning the M.S. at Illinois have a limit of 7 years, and students earning the M.S. at another institution have a limit of 6 years to complete the PhD. Students who are making adequate progress can petition for a time extension.

Statement of Interest in Pursuing the Ph.D. in Civil and Environmental Engineering. On campus M.S. students who are interested in pursuing the Ph.D. in Civil and Environmental Engineering, and who have not yet identified a research advisor, should submit a new graduate student application by the regular deadlines (e.g., by January 1 for fall applicants) for applicants wanting to be considered for Ph.D. program. If students have a PhD research advisor identified and are within two semesters of being awarded their M.S. degree, they may fill out a Graduate Student Request Form on the Graduate College Student Portal https://go.grad.illinois.edu/student-portal and change curriculum to the Ph.D. Students that have previously been in the Illinois MS program must re-apply for the PhD if it has been longer than a year since they finished the MS and if they do not have a PhD advisor.

Application for Admission to Candidacy for the Ph.D. and Area Qualification Procedures. A student who has identified a faculty member that agrees to supervise and financially support their doctoral program studies must do two things to work toward the CEE Ph.D. degree: (1) formally apply for admission to the doctoral program, and (2) pass the qualification procedures set by their area of specialization. The Department encourages students to apply for admission to the doctoral program as soon as possible after completing their M.S., or if the student obtained his or her M.S. degree elsewhere, as soon as possible after arriving at Illinois. The application for admission entails finding a faculty member who will agree to supervise the student's doctoral program. Table 1 on page 19 summarizes the doctoral candidate qualification procedures of each departmental area. Although each area has slightly different procedures and schedules, the Department requires that the qualifying procedures must be completed/passed within two years of enrolling in the Ph.D. program.

In addition to the area qualifying procedures, there is an interdisciplinary qualifying procedure available. Students must declare their intent to pursue the interdisciplinary qualifying procedure within the first year of the Ph. D. program. Students should consult with their advisor for further information.

A student is not permitted to attempt the qualifying procedure in more than one area. If a student's major research advisor is in another department or leaves the campus, a regular tenured or tenure-track CEE faculty co-advisor is required. If a student's major research advisor is in another department or is a non-tenure track CEE faculty, a regular tenured or tenure-track CEE faculty must serve as the chair of the preliminary and final examination committees.

Students who are admitted to the Ph.D. program in CEE generally have an M.S. degree, but a student may be directly admitted to the Ph.D. program with a B.S. degree. However, the student must complete courses to satisfy the Phase I course requirements. Please see page 22 for more info on the Direct PhD program.

A student who has been admitted to the Ph.D. program in our Department is automatically awarded Stage I credit for his or her M.S. degree. This determination is made by the area admissions committee at the time of application based on an evaluation of the courses taken for the M.S. degree (. Except in very rare cases, the existing M.S. degree will be in the same area as the Ph.D. sought by the student because it is unlikely that a student would be admitted to the program without adequate training in that field. Hence, it is generally not possible to receive a M.S. degree from Illinois because the M.S. would duplicate the one for which Stage I credit was already awarded.

A student with an M.S. degree from another institution can apply to the M.S. program in our department. If that student is admitted, it is with the understanding that the existing M.S. is not suitable for Phase I Ph.D. credit. In essence, admission to the M.S. program automatically disqualifies prior course work at other institutions from serving as Phase I Ph.D. credit. Hence, a subsequent petition to have courses which were taken for the M.S. at Illinois to count as Phase II credit for the Ph.D. would be denied because the first M.S. is not adequate for Phase I credit.

Language Requirement. There is no department-wide foreign language requirement. However, the faculty of some areas of specialization may require foreign language proficiency, if essential to the conduct of research in that area.

Professional Development Opportunities

- Center for Innovation in Teaching & Learning (CITL): This Center (http://citl.illinois.edu) offers several different teaching certificate programs that students can pursue, in addition to teaching workshops, private consultation on teaching, teaching evaluation tools, and other information on teaching resources available on campus (e.g., courses on teaching).

- Technology Entrepreneurship Center: The Center provides students and faculty with the skills, resources, and experiences necessary to become successful innovators, entrepreneurs, and leaders who tackle grand challenges and change the world. Information on relevant courses, certificate programs, events, and awards can be found at http://tec.illinois.edu/.

- ENG 598 TL: Teaching and Leadership: This course allows students to develop professional skills through practical training in classroom management and leadership; review pedagogy and theory of learning. Create communities of practice through discussions and classroom observations; become familiar with campus resources for teaching improvement; discover cutting-edge teaching methods, including active learning and project-based learning through exposure to educational research topics. ENG 598 | Course Explorer (illinois.edu)

Preliminary Examination. A candidate for the Ph.D. degree must pass a preliminary examination to test his or her knowledge of the major and minor field of study. All students are required to complete the preliminary exam within 2.5 years of starting the Ph.D. program (post M.S.). Under special circumstances, a student who does not take the preliminary examination within 2.5 years can submit a petition with a plan to take the preliminary examination within 6 months. This petition will need to be approved by the student's advisor and the Director of Graduate Studies, or the student's registration will be blocked. If a student does not meet the revised date of an approved extension, their progress will not be considered adequate, and dismissal from the Ph.D. program may be recommended. Areas and programs are encouraged to recommend that students' *preliminary examination proposals not exceed 20 pages.* The student must submit a *Request for Appointment of Doctoral Committee* form on https://go.grad.illinois.edu/student-portal to set up the Preliminary Examination Committee at least two weeks prior to the scheduled exam date. Graduate College policy states, "The preliminary examination committee is appointed by the Dean of the Graduate College, upon recommendation of the unit executive office. It must include at least four voting members, three of whom must be members of the graduate faculty and two of whom must be tenured…Committee members should be chosen for their expertise in the student's research area, but may also be chosen to give diversity in viewpoint, methodology, or academic discipline."

In CEE, the preliminary examination committee is normally the same as the final examination committee. Preliminary exams may be open or closed at the discretion of the committee chair and may be in-person or remote.

Work in Absentia. A student who has passed the preliminary examination, has completed the credit requirements for the doctoral degree, is making no use of university facilities and/or has left the campus, must still be registered as a full-time student with 9 hours of credit unless they qualify for one of the exceptions on pg. 8. Students must be registered during the term in which the final examination is taken, including the summer session. If more than one year has elapsed since the last semester in which the student was registered, the student must petition for re-entry. A student not on campus can register in absentia during a term in which that student does not expect to receive a

degree. In absentia registration is not permitted for students enrolled in courses meeting on campus. Petitions for in absentia registration will usually be approved if the student has completed 64 hours of residence credit, passed the preliminary examination, and not exceeded the time limit for the degree. If a student does not complete the degree requirements within five years after passing the preliminary examination, a second preliminary examination is required. This does not alter the time limit for the advanced degree as previously described.

Thesis. The degree of Doctor of Philosophy is primarily a research degree and consequently the candidate must demonstrate a capacity for independent research by preparing an original thesis topic within the chosen field of study. The subject of the thesis must be reported to the doctoral committee and to the Graduate College at the time of the preliminary examination. The completed thesis format must be officially checked by the Department. Joan Christian (jchristn@illinois.edu) is authorized to perform the departmental format check. Directions regarding thesis form and style are available at http://www.grad.illinois.edu/thesis-dissertation.

Final Examination. After the credit requirements for Stage III and the thesis have been completed, the candidate is admitted to the final examination upon recommendation of his or her advisor. Final examinations may be oral and public, but also may be remote. A student who has failed to maintain high standards of scholarship and research will be refused admission to the final examination. Although the examination is concerned primarily with the research accomplished by the student as described in his or her thesis, it may extend over the candidate's whole field of study. The student is required to submit a Request for Appointment of Doctoral Committee form on the Graduate College student portal at least two weeks in advance of the exam at https://go.grad.illinois.edu/student-portal. A copy of the abstract must be sent to Joan Christian two weeks prior to the exam to post on the Grad Blog.

Graduation. Students are responsible for notifying the Graduate College of their intention to graduate in a given semester; that is, students are responsible for placing their names on the "degree list." Students may use the University of Illinois at Urbana-Champaign Enterprise Applications – Student Self-Service system (https://apps.uillinois.edu/selfservice/) to place their name on the graduation list by the stated deadline.

Summary of Doctoral Candidate Qualification Procedures for Each CEE Area

* The Interdisciplinary Qualification Procedure is primarily used by SRIS, EWES, and SRHM.

Area	Area Doctoral Candidate Qualification Procedures
Construction Management	Students may apply to become a doctoral candidate in the construction management area after having received a master's degree and after having completed an additional 8 hours of study at Illinois. The student must first find a faculty member (advisor) willing to supervise his or her doctoral studies. Upon receiving an application to the Ph.D. program, the student's advisor will form a committee of construction management and other appropriate faculty members to review the student's qualifications. At a meeting of this committee, the student's records, including courses and grades at the Illinois, will be reviewed and the student will be asked to make an oral presentation of previous research or scholarship such as the results of his or her master's thesis or a special project.
Construction Materials	Students must complete the qualifying examination no later than the end of the third semester of their doctoral program and after completing at least four CEE 400- or 500-level courses. At least 7 days prior to the exam, the student must submit to his/her advisor an application packet consisting of a one-page statement of research objectives, a Ph.D. Program Plan, transcripts of all college-level courses, a professional resume, and a list of classes that establish the basis of the oral exam. A post-BS GPA of 3.5 or greater is required. The Qualification Examination is a one-hour oral exam in addition to review of the application packet.
Environmental	The Qualifying Examination should be taken upon completion of the appropriate core and specialty courses ***before the completion of 40 credit hours*** of post-bachelor's courses. Students who transfer into the environmental engineering program with a master's degree should take the qualifying examination ***before completion of one year*** in the program and are required to take it no later than the beginning of their fourth semester in the program. The examination will be offered one to two weeks prior to the beginning of courses in the fall and spring semester. The examination includes a three hour written exam, one take-home written exam, and a follow-up oral exam. Three pre-selected faculty members participate in the grading decision.
Geotechnical	Students may apply to become a doctoral candidate in the geotechnical area only after having completed a minimum of two semesters of graduate study at Illinois. They must have a minimum of two 500 level courses in geotechnical engineering and a 3.5 minimum GPA. Upon receiving an application to the Ph.D. program, the group coordinator will arrange a meeting of the geotechnical faculty. The exam format will be a written exam followed by an oral exam. A majority of faculty in attendance must approve of passing decision.
Structural	Students must complete a written qualifying examination that covers five core areas of structural engineering: analysis of truss and frame structures, structural dynamics, structural mechanics, concrete structures and steel structures. Students must pass an offering of the QE exam within 16 months of starting their post MS graduate work. The exam is offered in the fall and spring semesters each academic year and details of the exam are given at the start of each semester.
Transportation	The student, in consultation with his/her advisor, declares in writing to the transportation qualifying procedure (QP) coordinator the intent to pursue the Transportation QP. This QP must be taken before the end of the third semester of graduate studies following award of the M.S. degree or 36 hours after BS degree. The advisor and the student appoint a committee consisting of three faculty with at least two from transportation and two out of three must be tenure-track faculty. The qualifying exam is a two-hour oral examination or the interdisciplinary format. Please consult with your advisor.
Water Resources Engineering and Science	Students may apply to become a doctoral candidate after having completed two semesters of study at Illinois. Students earning their M.S. degrees at Illinois in the environmental hydrology and hydraulic engineering area STRONGLY ENCOURAGED to apply to become a doctoral candidate within one year after earning their M.S. degree. Students earning their M.S. degrees from other institutions are required to apply to become a doctoral candidate within two years after the start of their study at Illinois. Approval of the faculty is based upon performance in courses and in a weekend-long, take-home, written qualifying examination administered in January, followed by an oral qualifying examination. The oral exam should occur within 3 weeks of the date of the written exam.
Interdisciplinary*	The Director of Graduate Studies (DGS), in consultation with the student and advisor, appoints a committee of at least three faculty that includes a minimum of two faculty from CEE. The student's advisor (from CEE) serves as the committee chair. The committee chair works with the committee to define the exam format at least 30 days prior to the exam. There are two primary formats, which are either (1) combination of a written and oral exam covering the area of specialization knowledge or (2) written set of questions in the area of specialization that the student must orally respond to the committee.

Special Graduate Degree Programs and Options

Computational Science and Engineering (CSE) Concentration. The Department of Civil & Environmental Engineering offers a transcriptable option in Computational Science and Engineering (CSE) within the M.S. and Ph.D. program. The program requirements listed are in addition to the normal requirements for the M.S. and Ph.D. degree. See https://cse.illinois.edu/cse-educational-programs/graduate-concentration/

Graduate Concentration in Entrepreneurship and Innovation. The Grainger College of Engineering Technology Entrepreneur Center offers a transcriptable concentration in Entrepreneurship and Innovation. With the approval of their advisor, CEE MS and PhD students who complete this concentration can use the credit toward their CEE degrees. The concentration requirements can be found at https://tec.illinois.edu/academics/graduate-concentration.

Master of Architecture and Master of Civil Engineering (Construction Management or Structural Engineering). This program is administered through the school of architecture and requires a baccalaureate in architectural studies. Thus, the program is intended for graduate students in architecture. Ideally, students should apply for both programs at the same time. The CEE requirements for the MS degree in this joint program are 32 hours of course work including three 500 level courses in CEE. The student must be enrolled in Architecture the first year (fall and spring) and the second year in the CEE Department (fall and spring) in order to obtain the joint degree. A curriculum change petition will be necessary before the second year to change to CEE. Architecture also has information at https://arch.illinois.edu/programs-applying/graduate-degrees/. The thesis option is not available for this joint degree program.

Joint Degree Option in the Master of Urban Planning. This program is administered in the Department of Urban and Regional Planning. Students must apply for admission to both the Urban Planning program and the Department of Civil and Environmental Engineering. The requirements for the MSCE degree in this joint program are 32 hours of course work including three 500 level courses in CEE. The student must be enrolled in the CEE Department for at least two semesters in order to obtain the joint degree. See http://catalog.illinois.edu/graduate/faa/joint-degree/urban-planning-mup/ for additional information.

Direct PhD Program. As of Spring 2021 admissions, the CEE Department has a Direct Ph.D. program, which allows highly qualified applicants to be admitted directly into the Ph.D. program without a M.S. degree. The admission application for this program must be supported by a faculty advisor and CEE area. The direct Ph.D. program has the same coursework requirements as the MS plus Ph.D. route. However, students in the direct Ph.D. are not required write a M.S. thesis and do not necessarily have to earn a M.S. degree. The table below lists the general requirements for completing a degree through the direct admit PhD program.

Students admitted into the MS degree program must wait at least one semester to petition to be in the Direct PhD program and have a written endorsement from their research advisor to switch from MS to PhD. The Director of Graduate Studies will make the final decision of this switch based on advisor endorsement, the guarantee of 5-years of funding and the academic performance of the student based on their current GPA.

New 96 Credit Hour Direct Ph.D. Option, CE and EE

Code	Title	Hours
CEE 599	Thesis Research (min-max applied toward degree)	32-40
Elective courses (subject to Other Requirements and Conditions below)		56-64
Total Hours		**96**

Other Requirements

Requirement
Other Requirements and Conditions may overlap
A maximum of 8 hours of CEE 597 (or other independent study) may be applied toward the elective course work requirement; approval required.
There is no department-wide foreign language requirement. However, the faculty of some areas of specialization may require foreign language proficiency if essential to the conduct of research in that area.
24 credit hours must be in major field. 24 credit hours of elective coursework must be at the 500-level, with at least 12 hours in major field.
64 graduate hours must be completed in residence.
Ph.D. exam and dissertation requirements:
Qualifying exam to be completed at 2 years or after the student finishes 36 hours
Preliminary exam to be completed by the 3rd year
Final exam or dissertation defense
Dissertation deposit
The minimum program GPA is 2.75.

Financial and Other Assistance

Grainger Engineering Ph.D. students in their first five years of enrollment are guaranteed a tuition-waiving appointment for fall and spring, which includes a full tuition waiver, a partial fee waiver, and a monthly stipend. Students are also eligible for summer support. Students must remain in Good Academic Standing (see the Graduate College Handbook, Part I, Chapter 3.2) and successfully perform the duties of their assistantships to maintain this GCOE guarantee.

Fellowships. Fellowship stipends are awarded in recognition of scholarly achievement and promise, and are intended to enable a student to pursue graduate study and research without requiring him or her to render any services. The stipends of different fellowships vary, and many include or are supplemented with a tuition and partial fee waiver. A fellow is required to register during each semester of the appointment. Most fellows hold quarter-time teaching or research assistantships. If the fellow also holds an assistantship appointment, the student must register full time (9 hours) to uphold the requirement of the assistantship. The University adheres to the resolution adopted by the Council of Graduate Schools in the United States which provides that if the recipient of an award indicates acceptance before April 15th, he or she will have complete freedom through April 15th to resign in order to accept another appointment. After April 15th, however, the recipient may not accept another award without obtaining a formal release from the first commitment. This resolution applies to the acceptance of research or teaching assistantships and fellowships.

Departmental Recommendations for Fellows. The Department urges all students holding fellowships to engage in some form of research, either in association with one of the Department's formal research programs, or on a special research program with a faculty member. Fellows may arrange to write a Master's thesis (CEE 599) or write a comprehensive report on an individual investigation (CEE 597). This phase of the program provides the student with valuable training and serves as a guide to the Department in making decisions about continuing studies and stipends. Second-year fellows will be involved in, research (and should be enrolled for credit accordingly) as part of their doctoral study.

University Fellowships. These fellowships are based on academic and scholarly achievements and are unrestricted as to the student's field of graduate study.

Graduate College Fellowships. The Graduate College provides support to outstanding graduate students through a number of fellowship programs. Information can be obtained from the Graduate College , https://grad.illinois.edu/fellowship/competitions

Industrial, Endowed, and Special Fellowships. Various industrial firms, foundations, and private individuals have generously donated funds to support a number of special fellowships for graduate students. The stipends and supplemental allowances of these fellowships are not uniform, except that tuition and partial fees are usually provided.

Tuition and Fee Waivers. The Department does not provide tuition and fee waivers. Students who receive prestigious awards such as the Fulbright Fellowship may be eligible for an exemption from payment of tuition and some fees for the academic year and the summer session pending Graduate College approval. Students holding tuition and fee waivers must be in residence at the University and must register each semester during the academic year. They may accept part-time or incidental employment not to exceed twenty hours a week. Employment may be at the University or elsewhere. Veterans who are admissible to a graduate program and who meet certain residency requirements may be eligible for exemption from tuition under the statute concerning military scholarships.

Second MS Degree on way to PhD. Students who wish to earn another professional MS degree on the way to the PhD will need to check with Joan Christian in 1108 Newmark before transferring to the other program. If the program is a reimbursement seeking program https://grad.illinois.edu/handbook/program-tuition-waiver-designations, the CEE Department will not reimburse tuition for the time they are in the other department. If they have a tuition waiver from CEE, the student will have to pay their own tuition during this time. A PhD student should first complete the PhD in CEE and then register in the other department to get the second MS.

Research Assistantships. An assistant's hours of work per week are reflected in their percentage of appointment. Time commitments are based on a 40 hour work week. Thus, a one-half (50%) time appointment requires an average of 20 hours per week. A quarter (25%) time appointment requires an average of 10 hours per week. Hours of work are separate and distinct from the time required for an assistant's own academic course work. To receive and hold an assistantship, a student must be registered for the semesters of the appointment. The appointment will be in effect only while the student remains in good academic standing.

Students holding appointments ranging from 25 to 67 percent time (25 to 50 percent for international students) for at least three-fourths of the semester are exempt from tuition. The waiver of tuition includes payment of the service fee, health service fee, along with basic dental and vision coverage and partial payment of the health insurance fee for each term of the appointment. The student is responsible for paying the balance of the health insurance and all other fees. Information about fees you may be responsible can be found at https://grad.illinois.edu/gradmap/tuition-and-fee-waivers. The tuition and service fee exemption extends through the summer appointment; however, students who hold summer appointments of less than 25 percent or more than 67 percent will be assessed tuition and fees.

For more information about assistantship policies, see the Graduate College Handbook at http://www.grad.illinois.edu/gradhandbook, Chapter 8, page 54.

Faculty must notify graduate students (MS and PhD) with research or fellowship appointments in writing three months before the end of the semester that they no longer have any funding to support the student (in case of MS student) or they no longer wish to continue as their advisor. The faculty must also inform the Director of Graduate Studies at the same time. The graduate student is then allowed time to find another advisor and funding to support their graduate research. If the student is informed of discontinued funding or if the faculty resigns as advisor less than 3 months from the end of the semester or the student is good academic standing and is making satisfactory progress toward their degree and is still under a funding offer, the faculty is responsible to use their ICR or discretionary funds or other type of appointment (e.g., TA) to support the student the next semester.

Teaching Assistantships. The Department offers a limited number of teaching assistantships, which are usually filled by appointment of advanced-level graduate students whose competencies have been demonstrated. However, applicants who have particular interests and/or prior experience in teaching are encouraged to indicate this on their applications so that, when appropriate, consideration can be given to the possibility of an initial appointment as a teaching assistant. Applicants whose native language is not English are required to take the Oral English Assessment Interview (OEAI) before they can be appointed as teaching assistants unless their TOEFL Speaking score is 24 or above. If your native tongue is not English and if there is any possibility that you might want to become a teaching assistant, you may need to take theOEAI (https://linguistics.illinois.edu/testing/oeai). By law, the Department cannot appoint students whose first language in not English to such positions without the student first demonstrating their fluency in English. First-time teaching assistants must go to the Graduate Academy training or ENG598TL course to prepare for classroom teaching responsibilities.

Other Sources of Financial Aid. A number of other sources of support are available, for example, fellowships offered by the National Science Foundation, the Ford Foundation, the American Institute of Steel Construction, and other organizations. Students are encouraged to apply for such stipends.

Loan Funds. Information may be requested about National Direct Student Loans, University of Illinois Long Term Loans (UILT) and College-Work Study from the Office of Student Financial Aid, Student Services Arcade Building, 620 East John Street, Champaign, Illinois 61820. The application period begins in January of each year; the priority deadline for applications is March 1st. Loan and work-study applications are made separately from applications for fellowships, assistantships, or tuition and fee waivers. Graduate students may also apply for guaranteed loans through lenders in their hometowns who may participate in one of the various types of guaranteed loan programs. Applications should be submitted late in the spring term for the following academic year. Information brochures and application forms are available from the Office of Student Financial Aid. Students should identify themselves as graduate students when requesting an application or a brochure.

Parental Leave for Graduate Students. Graduate assistants with waiver-generating appointments are entitled to up to two weeks of parental leave without loss of pay immediately following the birth of a child, or upon either the initial placement or the legal adoption of a child under 18 years of age. Eligible graduate assistants are those graduate students who hold an active waiver-generating appointment at the time the parental leave is taken. Further info may be found in the Campus Administrative Manual **https://cam.illinois.edu/policies/hr-53/**

The Writers' Workshop. The Writers' Workshop satellite location in 402 Grainger Library is available to assist undergraduate and graduate engineering students with their written work including class assignments, reports, theses, conference papers, resumes, and personal statements. The Workshop staff consists of expert writing teachers who can provide extensive feedback about the logic, format, and style of students' texts. If students are interested in this service, they should contact the Grainger Library satellite at (217) 333-8796 to schedule an appointment. More information https://writersworkshop.illinois.edu/.

Graduate College Advising Services and Mentoring Resources. The Graduate College offers advising walk-in hours and online resources in several areas to assist you with your academic and professional development needs. Good mentoring is a key element of graduate education. The Graduate College also provides some resources on finding mentors and fostering a productive relationship with your mentor(s). Information about advising and mentoring can be found at http://www.grad.illinois.edu/mentoring.

The CEE Department has adopted The Graduate College recommended mentoring guidelines for Faculty, Grad Students and Graduate Programs to follow. These guidelines are available at: https://grad.illinois.edu/sites/grad.illinois.edu/files/pdfs/mentoring-guidelines.pdf.

Counseling Center. The Counseling Center is located at 110 Turner Student Services Building, 610 East John Street, Champaign, (217) 333-3704, http://www.counselingcenter.illinois.edu/. The Counseling Center is committed to providing a range of services intended to help students develop improved coping skills to address emotional, interpersonal and academic concerns. The Counseling Center provides individual, couples and group counseling, and all of these services are paid for through the health services fee. The Counseling Center offers primarily short-term counseling, but they do provide referrals to the community when students could benefit from longer term services.

Graduate Level Courses

(https://courses.illinois.edu/)

CEE 401 Concrete Materials
Credit: 4 hours.
Examination of the influence of constituent materials (cements, water, aggregates and admixtures) on the properties of fresh and hardened concrete, concrete mix design, handling and placement of concrete, and behavior of concrete under various types of loading and environment. Laboratory exercises utilize standard concrete test methods. Field trips are held during some scheduled laboratory sessions. Prerequisite: CEE 300.

CEE 405 Asphalt Materials I
Credit: 3 or 4 hours.
Properties and control testing of bituminous materials, aggregates for bituminous mixtures, and analysis and design of asphalt concrete and liquid asphalt cold mixtures; structural properties of bituminous mixes; surface treatment design; recycling of mixtures. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 310.

CEE 406 Pavement Design I
Credit: 3 or 4 hours.
Analysis, behavior, performance, and structural design of highway flexible and rigid pavements; climate factors, drainage, traffic loading analysis, and life cycle cost analysis. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 310.

CEE 408 Railroad Transportation Engrg Credit:
3 or 4 hours
Principles and analysis of railroad transportation efficiency, economics, energy, and engineering; effect on production and markets. Railroad infrastructure; locomotive and rolling stock design, function, and operation. Computation of train speed, power, and acceleration requirements; railway traffic control and signaling. 3 undergraduate hours. 3 or 4 graduate hours.
Prerequisite: CEE 310.

CEE 409 Railroad Track Engineering Credit:
3 or 4 hours
Railroad track engineering concepts including track component and system design, construction, evaluation, maintenance, load distribution, and wheel-rail interaction. Design and analysis tools for railroad track engineering and maintenance. Field trip to observe railroad track system and components. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 310.

CEE 410 Railway Signaling and Control
Credit: 3 or 4 hours
Railway traffic control and signaling systems; train performance and scheduling tools; analysis of temporal and spatial separation of trains for safety and efficiency; train movement authority and operating rules, track circuit and wireless train position monitoring technology; interlocking design; railroad capacity modeling tools; economic analysis of traffic control system design, optimization, and selection. Field trip to observe signal system infrastructure and railway traffic operations control center. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 310.

CEE 411 RR Project Design & Constr
Credit: 3 or 4 hours.
Critical elements in the development and planning of railroad construction projects; project economic justification; route alternative analysis procedures; cost estimation; site civil design; computer-aided track design; surveying; construction management; construction procedures for typical railroad projects. Design project covering a typical railroad capital construction projects. Field trip to observe the construction of a railroad capital project. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 310.

CEE 412 High-Speed Rail Engineering
Credit: 3 or 4 hours.
Development, engineering, design and construction of high-speed rail (HSR) passenger transport systems with particular emphasis on the unique engineering elements of HSR technology. Key elements of HSR systems and subsystems including: core systems (trains, power, signal, communication and control), track system and civil infrastructure (earthwork, bridges, viaducts and tunnels). Also covered are basic design and construction of HSR stations and rolling stock maintenance facilities. 3 undergraduate hours. 4 graduate hours.

CEE 415 Geometric Design of Roads
Credit: 4 hours.
Highway classification; analysis of factors in developing a transportation facility; highway geometrics design and safety standards; roadway design element; human factors in roadway design; roadway location principles; intersection, interchange, and ramp design; drainage factors. Prerequisite: CEE 310.

CEE 416 Traffic Capacity Analysis
Credit: 3 or 4 hours
Fundamentals of traffic engineering; analysis of traffic stream characteristics; capacity of urban and rural highways; design and analysis of traffic signals and intersections; traffic control; traffic impact studies; traffic accidents. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 310.

CEE 417 Urban Transportation Planning
Credit: 4 hours.
Role of transportation in urban development and planning; characteristics of urban-person transportation systems and methods of analysis and forecasting of urban-person transportation demand; transportation systems management and capital improvement programming; and emphasis on the needs and activities of metropolitan planning organizations. Same as UP 430.

CEE 418 Public Transportation Systems
Credit: 3 or 4 hours.
Transit systems basics, demand issues, design standards, economic and sustainability implications. Transit service planning for shuttle, corridor, and network systems, hybrid hierarchical systems, paratransit and demand-responsive services. Management of transit systems, fleet operations, and crew scheduling. Operational issues, vehicle movement, headway and schedule control. 3 undergraduate hours. 4 graduate hours. Prerequisite: CEE 310 or equivalent.

CEE 420 Construction Productivity
Credit: 3 or 4 hours.
Application of scientific principles to the measurement and forecasting of productivity in construction engineering. Conceptual and mathematical formulation of labor, equipment, and material factors affecting productivity. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 320.

CEE 421 Construction Planning
Credit: 3 or 4 hours.
Project definition; scheduling and control models; material, labor, and equipment allocation; optimal schedules; project organization; documentation and reporting systems; management and control.
3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 320.

CEE 422 Construction Cost Analysis
Credit: 3 or 4 hours.
Application of scientific principles to costs and estimates of costs in construction engineering; concepts and statistical measurements of the factors involved in direct costs, general overhead costs, cost markups, and profits; the fundamentals of cost recording for construction cost accounts and cost controls. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 320.

CEE 424 Sustainable Const Methods
Credit: 4 hours
Identification of cutting edge sustainable construction materials, technologies, and project management strategies for use in the construction industry and evaluation of their potential to reduce the negative environmental impacts of construction activity. Examination of the current LEED for New Construction rating system, and case study analysis of highly successful recent "green construction projects" through student team assignments and presentations. Preparation for the LEED Green Associate professional licensing exam. 4 undergraduate hours. 4 graduate hours. Prerequisite: CEE 320; two of CEE 420, CEE 421, or CEE 422.

CEE 430 Ecological Quality Engineering
Credit: 2 hours
Characteristics of rivers and lakes which affect the management of domestic and industrial wastewaters; chemical hazards assessment, surveillance and biomonitoring, and review of regulations governing effluents. 2 undergraduate hours. 2 graduate hours. Prerequisite: CEE 330.

CEE 432 Stream Ecology
Credit: 3 or 4 hours
Description of physical, chemical, and biological characteristics in streams and rivers including an integrated treatment of the environmental factors affecting the composition and distribution of biota; emphasizes the application of ecological principles in aquatic ecosystem protection and management. Same as IB450

CEE 433 Water Technology and Policy

Credit: 3 or 4 hours
This course will cover technical and social concepts of water and wastewater treatment; water resources; water law, policy, and economics; and water in integrated systems. Emphasis will be on the intersection between engineering and policy. Communication is an important element of this course: engineers will learn to "speak" policy via writing assignments, multimedia presentation, and briefings. Course activities include lecture, discussion, presentations, and field trips. 3 undergraduate hours. 4 graduate hours. Prerequisite: CEE 340 or CEE 350.

CEE 434 Environmental Systems I

Credit: 3 hours
Introduction to the concepts and applications of environmental systems analysis. Application of mathematical programming and modeling to the design, planning, and management of engineered environmental systems, regional environmental systems, and environmental policy. Economic analysis, including benefit-cost analysis and management strategies. Concepts of tradeoff, non-inferior sets, single- and multi-objective optimization. Practical application to case studies to convey an understanding of the complexity and data collection challenges of actual design practice. Prerequisite: CEE 201 and CEE 330.

CEE 435 Public Health Engineering
Credit: 3 or 4 hours
Aimed at building a next generation of engineers who are able to incorporate the principles of public health in all engineering designs. The course starts with the basic principles of epidemiology (types, methods, models and limitations). Next, the course covers various modes of environmental toxicity and the models to represent these modes. The course then covers infectious diseases, various models to represent their spread, the effect of environmental factors and the role of public health in breaking the chain of infection. The course also discusses environmental, social and behavioral factors in public health (e.g. environmental tobacco smoke including E-vaping) in the prevalence of chronic diseases. Finally, we cover the topics on public health risk assessment and management. In every aspect of the topic, the role of engineering in solving the problems of public health is explored and emphasized. 3 undergraduate hours. 4 graduate hours. Prerequisite: CEE 330.

CEE 437 Water Quality Engineering
Credit: 3 hours
Fundamental theory underlying the unit processes utilized in the treatment of water for domestic and industrial usage, and in the treatment of domestic and industrial wastewaters. Prerequisite: CEE 330; credit or concurrent registration in TAM 335.

CEE 438 Science & Environmental Policy
Credit: 3 hours
Environmental treaties, the role of science and scientists in managing the national and global environment, effective science communication, scientific assessments, and the use of quantitative tools to inform policy decisions. 3 undergraduate hours. 3 graduate hours. Prerequisite: CEE 202 and IE 300, STAT 400, or equivalent introductory probability and statistics course. Senior and Graduate students.

CEE 440 Fate Cleanup Environ Pollutant
Credit: 4 hours.
Investigation of the regulatory and technical issues affecting solid and hazardous waste management, with an emphasis on the principles governing the transport, fate, and remediation of solid and hazardous waste in the subsurface, including advection, dispersion, sorption, interphase mass transfer, and transformation reactions. Prerequisite: CEE 330.

CEE 442 Env Eng Principles, Physical
Credit: 4 hours.
Analysis of the physical principles which form the basis of many water and air quality-control operations; sedimentation, filtration, inertial separations, flocculation, mixing, and principles of reactor design. Prerequisite: CEE 437.

CEE 443 Env Eng Principles, Chemical
Credit: 4 hours.
Application of principles of chemical equilibrium and chemical kinetics to air and water quality. Thermodynamics, kinetics, acid-base chemistry, complexation, precipitation, dissolution, and oxidation-reduction. Applications. Prerequisite: CEE 437.

CEE 444 Env Eng Principles, Biological
Credit: 4 hours.
Application of principles of biochemistry and microbiology to air and water quality, wastes, and their engineering management; biological mediated changes in water and in domestic and industrial wastewater. Prerequisite: CEE 443.

CEE 446 Air Pollution Sources, Transport and Control
Credit: 4 hours.
A design approach to air pollution fate and control for the protection of human health and welfare. Air pollution transport and deposition. Gaussian plume, chemical mass balance models. Gaseous and particulate air pollutant physical and chemical properties and control. Evaluation of air pollutant emission control strategies based on cost and regulatory requirements for compliance with regulatory ambient air quality standards. 4 undergraduate hours. 4 graduate hours. Prerequisite: CEE 331 or equivalent; CEE 202 or equivalent. Credit or concurrent enrollment in ATMS 302 or equivalent.

CEE 447 Atmospheric Chemistry
Credit: 3 hours.
Biochemical cycles of atmospheric trace gases, their interactions on global and regional scales, and their significance for the chemistry in the atmosphere. Important fundamental concepts central to understanding air pollutants, e.g., the formation of aerosols and the transformation and removal of species in the atmosphere. Same as ATMS 420. Prerequisite: CHEM 102; ATMS 201 or CEE 330.

CEE 449 Environmental Engineering Lab
Credit: 3 hours.
Traditional analysis tools and techniques in analysis, control, and design of natural and engineered environmental systems including air, water, wastewater, solid and hazardous waste, and ecological systems. Prerequisite: CEE 437 or CEE 446.

CEE 450 Surface Hydrology
Credit: 3 hours.
Descriptive and quantitative hydrology dealing with the distribution, circulation, and storage of water on the earth's surface; principles of hydrologic processes; methods of analysis and their applications to engineering and environmental problems. Prerequisite: CEE 350.

CEE 451 Environmental Fluid Mechanics
Credit: 3 hours.
Incompressible fluid mechanics with particular emphasis on topics in analysis and applications in civil engineering areas; principles of continuity, momentum and energy, kinematics of flow and stream functions, potential flow, laminar motion, turbulence, and boundary-layer theory. Prerequisite: TAM 335.

CEE 452 Hydraulic Analysis and Design
Credit: 3 hours.
Hydraulic analysis and design of engineering systems: closed conduits and pipe networks; hydraulic structures, including spillways, stilling basins, and embankment seepage; selection and installation of hydraulic machinery. Prerequisite: TAM 335.

CEE 453 Urban Hydrology and Hydraulics
Credit: 4 hours.
Hydraulic analysis and design of urban, highway, airport, and small rural watershed drainage problems; discussion of overland and drainage channel flows; hydraulics of storm-drain systems and culverts; determination of design flow; runoff for highways, airports, and urban areas; design of drainage gutters, channels, sewer networks, and culverts. Prerequisite: CEE 350.

CEE 457 Groundwater
Credit: 3 hours.
Physical properties of groundwater and aquifers, principles and fundamental equations of porous media flow and mass transport, well hydraulics and pumping test analysis, role of groundwater in the hydrologic cycle, groundwater quality and contamination. Prerequisite: CEE 350 and TAM 335.

CEE 458 Water Resources Field Methods
Credit: 4 hours.
Scientific principles of measurement technologies and protocols used for water-resources measurements and experimental design of field-scale water-resources and environmental studies. Planning field studies; instruments and protocols for surface-water, and water-quality sampling; description of data quality. One-half-day laboratory field trips to streamflow monitoring stations and groundwater monitoring wells nearby. Prerequisite: CEE 350

CEE 459 Ecohydraulics
Credit: 4 hours.
Interactions between hydraulic, ecological, and geomorphic processes in river environments at a wide range of both spatial and temporal scales. Draws upon and synthetize fundamental concepts from biology, ecology, fluid mechanics and morphodynamics, to apply them to truly interdisciplinary problems. Such an approach, coupled with hands-on experience involving planning, conducting and analyzing hands-on experiments at the Ven Te Chow Hydrosystems Laboratory and field surveys on local natural waters will provide the students with a broad perspective on the interconnections between physical and ecological systems. Students will apply their knowledge of fundamental processes to assess complex problems involving monitoring, management, conservation and restoration of ecosystems. Same as GGIS 459.

CEE 462 Steel Structures II
Credit: 3 or 4 hours.
Metal members under combined loads; connections, welded and bolted; moment-resistant connections; plate girders, conventional behavior, and tension field action. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 460

CEE 463 Reinforced Concrete, II
Credit: 3 or 4 hours
Strength, behavior, and design of indeterminate reinforced concrete structures, with primary emphasis on slab systems; emphasis on the strength of slabs and on the available methods of design of slabs spanning in two directions, with or without supporting beams. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 461

CEE 467 Masonry Structures
Credit: 3 or 4 hours.
Analysis, design, and construction of masonry structures. Mechanical properties of clay and concrete masonry units, mortar, and grout. Compressive, tensile, flexural, and shear behavior of masonry structural components. Strength and behavior of unreinforced bearing walls. Detailed design of reinforced masonry beams, columns, structural walls with and without openings, and complete lateral-force resisting building systems. 3 or 4 graduate hours. Prerequisite: CEE 461.

CEE 468 Prestressed Concrete
Credit: 3 or 4 hours.
Strength, behavior, and design of prestressed reinforced concrete members and structures, with primary emphasis on pretensioned, precast construction; emphasis on the necessary coordination between design and construction techniques in prestressing. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 461.

CEE 469 Wood Structures
Credit: 3 or 4 hours.
Mechanical properties of wood, stress grades, and working stresses; effects of strength-reducing characteristics, moisture content, and duration of loading and causes of wood deterioration; glued-laminated timber and plywood; behavior and design of connections, beams, and beam-columns; design of buildings and bridges; other structural applications: trusses, rigid frames, arches, and pole-type buildings; prismatic plates and hyperbolic paraboloids. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 460 or CEE 461.

CEE 470 Structural Analysis
Credit: 4 hours.
Direct stiffness method of structural analysis; fundamentals and algorithms; numerical analysis of plane trusses, grids and frames; virtual work and energy principles; finite element method for plane stress and plane strain. Credit is not given for both CEE 470 and ME 471. Prerequisite: CEE 360.

CEE 471 Structural Mechanics
Credit: 3 or 4 hours.
Beams under lateral load and thrust; beams on elastic foundations; virtual work and energy principles; principles of solid mechanics, stress and strain in three dimensions; static stability theory; torsion; computational methods. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: MATH 385 and TAM 251

CEE 472 Structural Dynamics I
Credit: 3 or 4 hours.
Analysis of the dynamic response of structures and structural components to transient loads and foundation excitation; single-degree-of-freedom and multi-degree-of-freedom systems; response spectrum concepts; simple inelastic structural systems; systems with distributed mass and flexibility. 3 undergraduate hours. 3 or 4 graduate hours. Prerequisite: CEE 360, MATH 285, and TAM 212.

CEE 473 Wind Effects on Structures
Credit: 4 hours.
This course treats fundamental aspects of wind engineering – defined here as the salient characteristics of the wind and its effects on the built and natural environment. Students are expected to understand the behavior of wind relevant to wind engineering, the mechanisms for induced loading from wind, and associated structural responses. Specific topics include prediction of wind speeds for structural design, the atmospheric boundary layer, bluff-body aerodynamics, dynamic analysis, use of wind tunnels, wind loading on low-rise and high-rise buildings, wind loading on bridges, windstorm damage and risk. As the wind is a stochastic process, simulation of large data sets of wind speed, wind-induced pressure, and structural responses are required. Treatment of wind engineering topics for structural design for wind in codes and standards such as those in ASCE 7 are discussed. Field work is required as part of the course. 4 undergraduate hours. 4 graduate hours. Prerequisite: CEE 202 or STAT 400, TAM 335, and CEE 360.

CEE 474 Mechanics of Additive Manufacturing
Credit: 3 or 4 hours
Introduction to process physics for additive manufacturing (AM); Basic materials science for AM, cement-based materials, polymer-based materials. Fundamental mechanics principles involved in layered additive manufacturing; Mathematical models for AM, transport phenomena and flow modeling, curing and property evolution, residual stresses and fatigue effects; Introduction to the Role of Robotics, Machine Learning and Data Science in modern AM. 3 undergraduate hours. 4 graduate hours. Prerequisite: MSE 280, or CEE 300, or ME 330, or CEE 471, or consent of instructor.

CEE 483 Soil Mechanics and Behavior
Credit: 4 hours.
Composition and structure of soil; water flow and hydraulic properties; stress in soil; compressibility behavior and properties of soils; consolidation and settlement analysis; shear strength of soils; compaction and unsaturated soils; experimental measurements. Prerequisite: CEE 380.

CEE 484 Applied Soil Mechanics
Credit: 4 hours.
Application of soil mechanics to earth pressures and retaining walls, stability of slopes, foundations for structures, excavations; construction considerations; instrumentation. Prerequisite: CEE 483.

CEE 490 Computer Methods Credit: 3 or 4 hours.
Computer methods and their programming for solving common types of differential equations arising in civil and environmental engineering (hyperbolic, parabolic, and elliptic equations, with emphasis on prototypical cases, such as the convection-diffusion equation, as well as Laplace's / Poisson's equation). Exposure to state-of-the-art open-source numerical methods libraries. The course enables students in civil and environmental engineering to develop high-performance and high-purpose codes in these open-source frameworks for their research problems in an efficient way. 3 undergraduate hours. 4 graduate hours.
Prerequisite: CEE 360 and TAM 335.

CEE 491 Decision and Risk Analysis
Credit: 3 or 4 hours.
Development of modern statistical decision theory and risk analysis, and application of these concepts in civil engineering design and decision making; Bayesian statistical decision theory, decision tree, utility concepts, and multi-objective decision problems; modeling and analysis of uncertainties, practical risk evaluation, and formulation of risk-based design criteria, risk benefit trade-offs, and optimal decisions. 3 undergraduate hours, 3 or 4 graduate hours. Prerequisite: CEE 202.

CEE 492 Data Science for Civil and Environmental Engineering
Credit: 3 or 4 hours.
Students will learn to leverage data to study civil and environmental engineering problems, identify patterns, and make actionable insights. This course includes training in computational thinking and exploratory data analysis; data processing techniques including singular value decomposition, principal component analysis, and Fourier and wavelet transforms; and machine learning techniques including k-means, classification trees, neural networks, and neural differential equations. Students are required to bring a laptop computer to class. 3 undergraduate hours. 4 graduate hours. Prerequisite: CS 101; CEE 202; and CEE 300, CEE 330, or CEE 360.

CEE493 Sustainable Design Eng Tech
Credit: 4 hours
Quantitative sustainable design (QSD) and how to navigate engineering decision-making. Economic (life cycle costing, techno-economic assessment) and environmental (life cycle assessment, LCA) sustainability assessments, and how to link these tools to design decisions under uncertainty. Design of engineered technologies individually and in teams, with special attention to water infrastructure and bioenergy production. Semester-long design project that includes components from two of the following three CEE sub-disciplines: environmental, hydraulic, geotechnical. Prerequisite: CEE 340 or graduate standing.

CEE 497 Independent Study
Credit: 1 to 16 hours.
Individual investigations or studies of any phase of civil engineering selected by the student and approved by the department. 1 to 4 undergraduate hours. 1 to 16 graduate hours. May be repeated. Prerequisite: Consent of instructor.

CEE 498 Special Topics*
Credit: 1 to 4 hours.
Subject offerings of new and developing areas of knowledge in civil and environmental engineering intended to augment the existing curriculum. See Class Schedule or departmental course information for topics and prerequisites. Sample topics: Construction Equipment & Methods, Rail Vehicle Technology, Wind Engineering, Ecohydraulics, Case Histories in Infrastructure, Public Health Engineering. May be repeated in the same or separate terms if topics vary.

CEE 502 Advanced Cement Chemistry
Credit: 4 hours.
Advanced topics in chemistry of portland cement, chemistry and microstructure of cements, chemical reactions that lead to hardening, chemistry and microstructure of hydrated cements, effects of chemical and mineral admixtures, and chemical issues involved in the engineering behavior of the cements. Prerequisite: CEE 401.

CEE 503 Constr Matls Deterioration
Credit: 4 hours.
Fundamental processes for deterioration mechanisms of infrastructure materials: corrosion of metals including thermodynamics, kinetics, passivity and rate measurements; degradation of cement-based materials including freezing and thawing, ASR, sulfate attack, fire attack and steel reinforcement corrosion; degradation of organic materials including photo-oxidation and ageing. A research literature review exercise related to material degradation. Prerequisite: CEE 401 or CEE 405.

CEE 504 Infrastructure NDE Methods
Credit: 4 hours.
Fundamental bases and methodologies of non-destructive evaluation (NDE) techniques for infrastructure materials: methods for steel including ultrasound, radiography, eddy-current and magnetic-particles; methods for concrete including sounding, semi-destructive, ultrasound, seismic, impact-echo, impulse-response, ground-penetrating radar, infrared-thermography, and nuclear; planning and carrying out NDE structural investigations. Weekly laboratory sessions, a research paper, and an associated presentation related to NDE required.Prerequisite: CEE 401 or CEE 405.

CEE 505 Transportation Soil Stabilization
Credit: 4 hours.
Aims to introduce theory, techniques and applications of chemical and mechanical stabilization of soils and aggregates used in construction and maintenance of roads, railroads, and airfields. Chemical stabilization includes use of lime, cement, fly ash, and emulsions as compaction aids to soils, as binders and water repellents, to treat weak soils and aggregates. Mechanical stabilization deals with the use of non-biodegradable reinforcement, such as geosynthetics and fibers, to improve strength and stiffness. 4 graduate hours. 4 professional hours. Prerequisite: CEE 483.

CEE 506 Pavement Design, II
Credit: 4 hours.
Development of layered elastic and plate theory models for area analysis of pavement systems; performance prediction of flexible and rigid pavements; characterization of aircraft traffic; design of airfield pavement systems; construction material fatigue and failure criteria (strength theory and fracture mechanics); industrial floor and reinforced concrete slab design; climatic factors. Prerequisite: CEE 406.

CEE 508 Pavement Evaluation and Rehab
Credit: 4 hours.
Concepts and procedures for condition survey assessment; pavement evaluation by nondestructive testing and data analysis (roughness, friction, structural capacity, internal flaws, and thickness measurements): destructive testing, maintenance strategies, rehabilitation techniques of pavement systems for highways and airfields, cost analysis, preservation techniques. Prerequisite: CEE 406.

CEE 509 Transportation Soils
Credit: 4 hours.
Occurrence and properties of surficial soils, soil classification systems, soil variability; subgrade evaluation procedures, repeated loading behavior of soils; soil compaction and field control; soil moisture, soil temperature, and frost action; soil trafficability and subgrade stability for transportation facility engineering. Prerequisite: CEE 483.1

CEE 511 Railway Terminal Design and Operations
Credit: 4 hours.
Geometric design, operations planning and optimization of terminal facilities required for the railway network to function as an efficient freight transportation system. Design of classification yards, intermodal facilities and bulk terminals, and organization of these facilities into an optimal freight transportation network. Horizontal yard track layout and turnout configurations; railcar rolling resistance, speed control and vertical profile design and simulation; railcar distribution, locomotive and crew assignment models. Design project covering a typical railroad terminal development. 4 graduate hours. No professional credit. Prerequisite: CEE 408 or CEE 409 or CEE 411.

CEE 512 Logistics Systems Analysis
Credit: 4 hours.
Planning, design and operations of complex logistics systems: logistics costs; production, transportation and distribution systems; lot-sizing; traveling salesman problem (TSP) and vehicle routing problem (VRP); transshipments; facility location problem; supply chain management and inventory control; order instability; analytical methods and practical solution techniques. Prerequisite: CEE 310 and IE 310.

CEE 515 Traffic Flow Theory
Credit: 4 hours.
Fundamentals of traffic flow, traffic flow characteristics, statistical distributions of traffic flow parameter, traffic stream models, car following models, continuum follow models, shock wave analysis, queuing analysis, traffic flow models for intersections, network flow models and control, traffic simulation. Prerequisite: CEE 416 and knowledgeof probability and statistics.

CEE 517 Traffic Signal Systems
Credit: 4 hours.
Theory and application of concepts in traffic signal systems control, signal timing design, signal cabinet components, signal controllers, traffic signal theory and control, vehicle detection technologies, communication methods, interconnected rail-highway crossing signals, signal coordination, and signal systems network. Field trips to observe or utilize equipment in the Traffic Operations Lab (TOL) in ATREL or similar facilities. Prerequisite: CEE 416.

CEE 521 Building Information Modeling
Credit: 4 hours.
Targeted to introduce and explore the application of Building Information Modeling (BIM) both as a product and a process. BIM is an approach to building and infrastructure project delivery in which a digital representation of the building process is used to facilitate the exchange and interoperability of information. Successful implementation of BIM generates significant benefits, including improved design quality, reduction in design errors, improved field productivity, reduction in conflicts and their associated changes, and finally reduction in construction cost and time. Prerequisite: CEE 420, CEE 421 and CEE 422 are recommended.

CEE 522 Visual Data Analytics
Credit: 4 hours.
An introduction to 2D and 3D visual sensing for data acquisition and analysis of buildings and civil infrastructure systems. It is intended mainly for graduate students who want to acquire basic understanding of the theoretical concepts as well as application of computer vision and image processing for sensing buildings, civil infrastructure systems and sustainable construction operations. 4 graduate hours. No professional credit. Prerequisite: CEE 420, CEE 421 and CEE 422 recommended

CEE 524 Construction Law
Credit: 4 hours.
Legal aspects of the construction process and the potential liability that engineers can incur through the design, and post-construction processes. Organization and operation of the American court system, contact formation, defenses, remedies, and typical areas of dispute, and design services contracts, torts, product liability, agency, business organizations, intellectual property, and risk managements. Mock trial of a recent construction-related case with the class serving as plaintiffs and defendants. Prerequisite: CEE 420, CEE 421, and CEE 422.

CEE 525 Construction Case Studies
Credit: 4 hours.
Case studies of bridges, tunnels, buildings, transportation systems, heavy industrial construction, waterways, and marine structures in the context of construction engineering and management. Research, a team-oriented term project, presentations, and discussions in studio-style format. Prerequisite: Two of CEE 420, CEE 421, and CEE422.

CEE 526 Construction Optimization
Credit: 4 hours.
Optimizing construction project decisions during the planning and construction phases including the optimization of bid decisions; contractor and material supplier selection; site layout planning; tradeoffs among construction time, cost and quality; repetitive construction scheduling; resource allocation and leveling; and building sustainability. 4 graduate hours. No professional credit. Prerequisite: One of CEE 420, CEE 421 or CEE 422.

CEE 528 Construction Data Modeling
Credit: 4 hours.
State-of-the-art research and literature in the construction data modeling domain. Fundamental techniques of construction data modeling; existing construction data representation approaches and specifications for the architecture, engineering, and construction domain; building information models; capabilities and limitation of data process models and representation approaches and techniques. Prerequisite: Two of CEE 420, CEE 421, CEE 422.

CEE 534 Surface Water Quality Modeling
Credit: 4 hours.
Mathematical modeling of the movement and fate of pollutants and other substances in streams, lakes, and other natural water bodies. Development of one-, two-, and three-dimensional differential conservation equations, one-, two-, and three-dimensional steady-state and transient solutions. Finite difference, finite element, and finite particle methods. Lagrangian and Eulerian formulations, diffusion and dispersion tensors, numerical dispersion, and solution stability. Kinetic relationships describing important physical, chemical, and biochemical water constituent transformation phenomena. Field or laboratory experiment in model calibration and verification. Prerequisite: MATH 285, CEE 442, and CEE 451.

CEE 535 Environmental Systems, II
Credit: 4 hours
Fundamental concepts of uncertainty, risk, and reliability applied to environmental and water resources decision making. Chance constraints, Markov and Monte Carlo modeling, geostatistics, unconditional and conditional simulation, genetic algorithms, neural networks, simulated annealing, and a review of relevant portions of basic probability and statistical theory. Many techniques are applied to a real-world environmental decision making problem initially developed in CEE 434. Prerequisite: CEE 202 and CEE 434.

CEE 537 Water Quality Control Proc I
Credit: 4 hours.
Theory and basic design of processes used in water and wastewater treatment, including adsorption, ion exchange, chemical oxidation and reduction, disinfection, sedimentation, filtration, coagulation, flocculation, and chemical precipitation. Prerequisite: Credit or concurrent registration in CEE 442 and CEE 443.

CEE 538 Water Quality Control Proc, II
Credit: 4 hours.
Theory and its application for design and operation of processes used in water and wastewater treatment; emphasis is on biological treatment processes and related processes for gas transfer, sludge dewatering, sludge disposal, and solids separations. Prerequisite: CEE 442 and CEE 443; credit or concurrent registration in CEE 444.

CEE 540 Remediation Design
Credit: 4 hours.
Evaluation and design of alternative treatment processes for hazardous waste sites contaminated with organic or metal wastes. Group design project due at the end of the term. Prerequisite: CEE 440.

CEE 543 Env Organic Chemistry
Credit: 4 hours.
Molecular-scale processes that control the fate of organic contaminants in natural environments and engineered treatment systems, including partitioning between environmental phases (water, air, organic, and biological phases), sorption onto solids (soils, sediments, aerosol particles), and transformation reactions (chemical, photochemical, and biochemical). Emphasis on quantitative approaches for predicting contaminant fate using thermodynamic principles and molecular property descriptors. Prerequisite: CEE 443 or NRES 490.

CEE 544 Advanced Surface Science
Credit: 4 hours.
The overall goal of this course is to provide an in-depth knowledge of surface science principles. The specific goals are to elaborate the classical theories, to identify their limitations from a fundamental level, and to provide the state-of-the-art extensions of classical theories, and alternative approaches based on recent literature. The course also seeks to provide students with state-of-the-art experimental approaches, and to provide a link between surface science and the student's research project or other interests, which is pursued through literature discussion in presentations and term paper. 4 graduate hours. No professional credit. Prerequisite: CEE 442.

CEE 545 Aerosol Sampling and Analysis
Credit: 4 hours.
Principles of sampling for particles and gases in the field of air pollution; instrumental techniques relevant to the design of sampling systems used in process control, ambient air monitoring, and laboratory experiments; methods of sample analysis and their limitations. Same as ATMS 535 Prerequisite: MATH 285 and CEE 446.

CEE 546 Air Quality Control
Credit: 4 hours.
Application of principles describing the generation, separation, and removal of air contaminants from gas streams generated by stationary sources. Typically includes local field trips to observe applications of the air quality control devices. Prerequisite: CEE 442 or equivalent and CEE 446.

CEE 550 Hydroclimatology
Credit: 4 hours.
Application of deterministic and probabilistic concepts to simulate and analyze hydrologic systems; discussion of the theory and application of linear and nonlinear, lumped, and distributed systems techniques in modeling the various phases of the hydrologic cycle. Prerequisite: CEE 450

CEE 551 Open-Channel Hydraulics
Credit: 4 hours.
Advanced hydraulics of free surface flow in rivers and open channels; discussion of theory, analytical and numerical solution techniques, and their applications to gradually and rapidly varied nonuniform flows, unsteady flow, and flow in open-channel networks. Prerequisite: CEE 451.

CEE 552 River Basin Management
Credit: 4 hours.
Multidisciplinary knowledge (hydrology, economics, systems engineering, etc.) and methodological skills (optimization, simulation, etc.) for river basic management. River basin characterization-natural and social features; water availability assessment based on hydrology, infrastructure, and policy; environmental flow requirements; water demand management and microeconomics theory; integrated river basin management modeling. Prerequisite: CEE 350 and CEE 434.

CEE 553 River Morphodynamics
Credit: 4 hours.
River morphology and characteristics of river sediment. Response of alluvial and bedrock rivers to changes in sediment supply, hydrology, and tectonics. Numerical modeling of river morphodynamics in gravel and sand bed rivers and deltas. Same as GEOL 573. Prerequisite: TAM 335.

CEE 554 Hydrologic Variability
Credit: 4 hours.
Advanced quantitative treatment of catchment hydrology, focusing on analysis of observed hydrologic and hydroclimatic variability, and their interpretation in terms of the underlying processes. Concepts of heterogeneity and variability, scale and scaling, process change and process interactions will be emphasized. Theoretical foundations of hydrologic applications, such as flood estimation, water balance analyses, hydrologic modeling and associated scale problems will be discussed in sufficient detail to prepare students to undertake advanced research and professional practice. Prerequisite: CEE 450.

CEE 555 Mixing in Environmental Flows
Credit: 4 hours
Physical processes involved in transport of pollutants by water; turbulent diffusion and longitudinal dispersion in rivers, pipes, lakes, and the ocean; diffusion in turbulent jets, buoyant jets, and plumes. Prerequisite: MATH 285 and TAM 335.

CEE 557 Groundwater Modeling
Credit: 4 hours.
Theory and application of numerical methods, finite differences and finite element, for solving the equations of groundwater flow and solute transport; transport of chemically reacting solutes; model calibration and verification. Prerequisite: CEE 457; MATH 285.

CEE 558 Environmental Hydrodynamics: Modeling of Boundary-layer Flows in Rivers, Lakes and Oceans
Credit: 4 hours
Introduction to dynamics, control, and modeling of flows in natural aquatic environments in the presence of space and time variations in density stratification caused by temperature, salinity, and suspended particles. Tools include scaling, dimensional analysis and turbulent boundary-layer theory leading to integral methods for solving flows such as plumes, density currents, thermal pollution, lake stratification, air-entrainment in spillways and salt wedges in estuaries. Integral methods are used to obtain engineering solutions followed by numerical modeling of turbulent boundary-layer flows in rivers, lakes and oceans. 4 graduate hours. No professional credit. Prerequisite: CEE 451.

CEE 559 Sediment Transport
Credit: 4 hours.
Physical processes of transportation and deposition of sediment particles in liquid bodies with particular emphasis on fluvial sediment problems; sediment in desilting basins; reservoirs and delta formation; erosion; stable channel design; river morphology. Prerequisite: CEE 551.

CEE 560 Steel Structures, III
Credit: 4 hours.
Theories of ultimate behavior of metal structural members with emphasis on buckling and stability of members and frames; theory of torsion applied to beam torsion, lateral-torsional buckling, curved beams with emphasis on design criteria; post-buckling strength of plates and post-buckling versus column behavior. Prerequisite: CEE 462.

CEE 562 Highway Bridge Design
Credit: 4 hours.
This course introduces current practices in highway bridge design. It provides students with the background to understand the American Association of State Highway and Transportation Officials (AASHTO) code. The course covers topics related the behavior, analysis, and design of bridge superstructure and substructure systems under various bridge loads. The course specifically addresses highway bridge types constructed using reinforced concrete, prestressed concrete, and steel. In addition, the course gets the students familiar with state-of-art methodologies adopted for bridge seismic retrofitting.

CEE 570 Finite Element Methods
Credit: 4 hours.
Theory and application of the finite element method; stiffness matrices for triangular, quadrilateral, and isoparametric elements; two- and three-dimensional elements; algorithms necessary for the assembly and solution; direct stress and plate bending problems for static, nonlinear buckling and dynamic load conditions; displacement, hybrid, and mixed models together with their origin in variational methods. Same as CSE 551. Prerequisite: CEE471 or TAM 551.

CEE 571 Computational Plates & Shells
Credit: 4 hours
Classical and first-order shear deformable plate and shell models: assumptions, applicability, valid boundary conditions, analytical solutions; finite element methods for plates and shells: convergence, instabilities, shear and membrane locking, mixed methods for plates and shells. Implementation and verification of finite elements for plates and shells; buckling of plates and shells; boundary layer effects; introduction to high order hierarchical plates and shell models and to isogeometric analysis of shells. Same as CSE 554. 4 graduate hours. No professional credit. Prerequisite: CEE 471 or TAM 551. Credit or current registration in CEE 570 Finite Element Methods or ME 471 Finite Element Analysis.

CEE 572 Earthquake Engineering
Credit: 4 hours.
Source mechanisms, stress waves, and site response of earthquake shaking; effect on the built environment; nature of earthquake actions on structures; fundamental structural response characteristics of stiffness, strength, and ductility; representation of the earthquake input in static and dynamic structural analysis; modeling of steel and concrete structures under earthquake effects; outputs for safety assessment; comprehensive source-to-design actions project. Prerequisite: CEE 472.

CEE 573 Structural Dynamics II
Credit: 4 hours.
Advanced concepts in structural dynamics and fundamentals of experimental structural dynamics. Modern system theory; data acquisition and analysis; digital signal processing; experimental model analysis theory and implementation; random vibration concepts; system identification; structural health monitoring and damage detection; pseudo-dynamic testing and model-based simulation; smart structures technology (e.g., smart sensors; passive, active, and semi-active control). Prerequisite: CEE 472.

CEE 574 Probabilistic Loads and Design
Credit: 4 hours.
Application of probabilistic methods in describing and defining loads on structures with emphasis on the random fluctuation in time and space. Random vibration methods and applications to dynamic response of structures under wind and earthquake loads. Computer simulation of structural loads and responses. Probability-based safety criteria and review of current methods of selection of design loads and load combinations. Prerequisite: CEE 202 and CEE 472.

CEE 575 Fracture and Fatigue
Credit: 4 hours.
Fatigue and fracture behavior of metallic structures and connections; fatigue and fracture mechanics theory; generation and use of laboratory data; background and application of international testing and assessment standards. Same as AE 521. Prerequisite: one of CEE 471, TAM 451, TAM 551.

CEE 576 Nonlinear Finite Elements
Credit: 4 hours.
Nonlinear formulations in solid mechanics and nonlinear equation solving strategies; finite deformation (hyperelasticity) elastostatics and elastodynamics, semi-discrete weighted residual formulations, implicit and explicit time-stepping algorithms and stability analysis; theory of mixed finite element methods, strain-projection methods, and stabilized methods; mixed methods for nonlinear coupled-field problems. Same as CSE 552. Prerequisite: CEE 471 or TAM 445; CEE 470 or ME 471

CEE 577 Computational Inelasticity
Credit: 4 hours.
Theoretical foundations of inelasticity and advanced nonlinear material modeling techniques; constitutive models for inelastic response of metals, polymers, granular materials, biomaterials. Phenomenological models of viscoelasticity, viscoplasticity, elastoplasticity, porous plasticity and cyclic plasticity. Small-strain and finite-strain numerical implementation and code development. Same as CSE 553. Prerequisite: CEE 471 or TAM 551; CEE 570 or ME 471.

CEE578 Structural Design Optimization
Credit: 4 hours
Covers the fundamental theory, classic numerical methods, modern techniques, and practical applications of structural optimization to engineering design problems, such as large-scale civil structures and mechanical systems. We will also introduce the modern topology optimization methods together with the application to material and structural systems. Students will also be introduced with rapid prototyping and 3D printing techniques. Also features a project, which will use those state-of-the-art techniques and methods, as well as practical design optimization problems from various engineering industries. 4 graduate hours. No professional credit. Prerequisite: CEE 470.

CEE 580 Excavation and Support Systems
Credit: 4 hours.
Classical and modern earth pressure theories and their experimental justification; pressures and bases for design of retaining walls, bracing of open cuts, anchored bulkheads, cofferdams, tunnels, and culverts. Prerequisite: Credit or concurrent registration in CEE 484.

CEE 581 Earth Dams
Credit: 4 hours.
Fundamentals of slope stability; seepage in composite sections and anisotropic materials; methods of stability analysis; mechanism of failure of natural and artificial slopes; compaction; field observations. Prerequisite: Credit or concurrent registration in CEE 484.

CEE 582 Consolidation of Clays
Credit: 4 hours.
Elastic solutions relevant to soil mechanics; permeability; general application of Terzaghi's theory of one-dimensional consolidation; advances in consolidation theories; mechanism of volume change; delayed and secondary compressibility and creep; theory of three-dimensional consolidation and solutions; radial flow and design of sand drains; analysis and control of settlement. Prerequisite: CEE 483.

CEE 583 Shear Strength of Soils
Credit: 4 hours.
Physico-chemical properties of soils; fabric and structure of soil; mechanism of shearing resistance; residual shear strength of overconsolidated clays and clay shales; long-term shear strength of over consolidated clays; Hvorslev shear strength parameters; undrained shear strength of clays. Prerequisite: CEE 483.

CEE 585 Deep Foundations
Credit: 4 hours.
Ultimate capacities and load-deflection of piles and drilled shafts subjected to compressive loads, tensile loads, and lateral loads; effects of duration of load, soil-structure interaction; two- and three-dimensional analysis of pile groups with closely-spaced piles; effects of installation; inspection of deep foundations and full-scale field tests. Prerequisite: CEE 484.

CEE 586 Rock Mechanics and Behavior
Credit: 4 hours.
Physical properties and classification of intact rock, theories of rock failure, state of stress in the earth's crust, stresses and deformations around underground openings assuming elastic, plastic, and time-dependent behavior; effect of geologic discontinuities on rock strength; stability analyses in rock. Prerequisite: CEE 483; TAM 451.

CEE 587 Applied Rock Mechanics
Credit: 4 hours.
Application of rock mechanics to engineering problems; shear strength of rock masses; dynamic and static stability of rock slopes; deformability of rock masses; design of pressure tunnel linings and dam foundations; controlled blasting and blasting vibrations; tunnel support; machine tunneling; design and construction of large underground openings; field instrumentation. Prerequisite: CEE 586.

CEE 588 Geotechnical Earthquake Engineering
Credit: 4 hours.
Seismic hazard analysis, cyclic response of soils and rock; wave propagation through soil and local site effects; liquefaction and post liquefaction behavior, seismic soil-structure of foundations and underground structures, seismic design of retaining walls, underground structures and tunnels. Construction and machine vibrations. Blasting. Prerequisite: CEE 472 and CEE 483.

CEE 589 Computational Geomechanics
Credit: 4 hours
Numerical modeling, multi-phase domain equations, constitutive modeling of soils and rock, continuum and discrete element modeling. Upper and lower bound limit analysis methods. Simulation of soil-structure interaction problems and construction activities. Prerequisite: CEE 483. Recommended: one of AE 420, CEE 470, CSE 451, or ME 471.

CEE 590 Geotechnical Field Measurement
Credit: 4 hours.
Discussion of observational method in geotechnical engineering. Historical, theoretical, experimental, and empirical development of in-situ tests and instrumentation in geotechnical engineering. Practical applications and limitation of field testing devices and instruments. Interpretation of test results and measurements for geotechnical site characterization. Discussion of data acquisition systems and data management. Introduction of emerging technologies in field testing and instrumentation. Prerequisite: CEE 483 and CEE 484.

CEE 591 Reliability Analysis
Credit: 4 hours.
Introduction to applied probability theory and random processes, Bayesian analysis of model uncertainties. Formulation of reliability for components and systems. Exact solutions for special cases. Approximate solutions by second-moments, first- and second-order reliability methods (FORM and SORM), the response surface method, simulation methods including importance sampling techniques. Reliability-based optimal design and probabilistic design codes. Time- and space-variant reliability formulations. 4 graduate hours. No professional credit. Prerequisite: CEE 491.

CEE 592 Sustainable Urban Systems
Credit: 4 hours.
Fundamental concepts of sustainability and resilience in urban systems, including the complex interactions among human, engineered, and natural systems. Project-based format, focusing on real-world problems solicited from government agencies, industry, and non-governmental organizations in one or more partnering cities. Students work in multidisciplinary teams with faculty advisors from multiple departments and colleges. Same as NRES 592 and UP 576. Prerequisite: one of ATMS 421, CEE 491, NRES 439, UP 456, UP 480, or equivalent course related to sustainable urban systems; and one of NRES 454, UP 418, GEOG 480, or equivalent course related to geographic information systems (GIS).

CEE 593 Tunneling in Soil and Rock
Credit: 4 hours
History of development of tunneling design and methods. Relationship of geology on anticipated ground response to tunneling. Study of tunneling methods unique to tunnels in soil, tunnels in rock, caverns in soils and caverns in rock. Analysis approaches for tunnels in soils and rock. Geotechnical Baselines report and other risk allocation tools for tunnel construction. Case histories of tunneling projects. 4 graduate hours. No professional credit. The course lectures will be scheduled for twice a week for 80 minutes each class during a 16 week semester. Prerequisite: CEE 483 required. Credit or concurrent enrollment in CEE 484 is required.

CEE 595 Seminar
Credit: 0 to 1 hours.
Discussion of current topics in civil and environmental engineering and related fields by staff, students, and visiting lecturers. Approved for S/U grading only. May be repeated.

CEE 597 Independent Study
Credit: 1 to 16 hours.
Individual investigations or studies of any phase of civil engineering selected by the student and approved by the adviser and the staff member who will supervise the investigation. May be repeated. Prerequisite: Consent of instructor.

CEE 598 Special Topics*
Credit: 1 to 4 hours.
Subject offerings of new and developing areas of knowledge in civil and environmental engineering intended to augment the existing curriculum. See Class Schedule or departmental course information for topics and prerequisites. Sample topics: Generalized FEM's, Globalization of Water, Highway Bridge Design, Electric Traction, Railway Terminal Design, Rail Vehicle Dynamics, Reliability Analysis, Uncertainty Quantification, Transportation Soil Stabilization, Stochastic Hydrology, Environmental Hydrodynamics, May be repeated in the same or separate terms if topics vary.

CEE 599 Thesis Research
Credit: 0 to 16 hours.
Approved for S/U grading only. May be repeated.

*For the current list of CEE 498 & 598 Special Topics courses visit https://courses.illinois.edu/

Appendix 1 – Procedures for Grievances

1. Introduction. This policy describes the procedures to be employed to resolve grievances by graduate students in the Department of Civil and Environmental Engineering. This policy applies to all graduate students and members of the academic community in the Department of Civil and Environmental Engineering. The purpose of this policy is to protect the interests of graduate students in the Department of Civil and Environmental Engineering (CEE) by providing informal and formal means of seeking resolution in case of a potentially inappropriate action of a member of the faculty or administrative staff or an inappropriate application of a departmental policy. Any current or former graduate student in the Department of Civil and Environmental Engineering may informally pursue or formally file a grievance when he/she believes that a decision or behavior adversely affects his or her status as a graduate student, as long as the student meets the timeliness requirements specified in this policy. This policy does not apply in cases of research misconduct. Breaches of academic integrity in research and publication are handled under the campus's *Policy and Procedures on Academic Integrity in Research and Publication*. Similarly, this policy does not apply to cases that arise under the *Code of Policies and Regulations Applying to All Students ("Code"),* such as capricious grading in a course (Section 26) or academic integrity (Section 33). The policies and procedures described in this document do not override or supersede any other policies as established in the University *Statutes* and campus policies.

2. Definition of a Grievance. A grievance may arise when a graduate student believes that his or her status as a graduate student has been adversely affected by an incorrect or inappropriate decision or behavior. Examples include, but are not limited to the following:

- inappropriate application of a department or university policy;
- being unfairly assessed on a preliminary examination;
- being improperly terminated from a program;
- being required to perform personal services unrelated to academic duties;
- being required to meet unreasonable requirements for a graduate degree that extend the normal requirements established by the campus or by the department and are inconsistent with the scholarly standards in the discipline;
- being the subject of retaliation for exercising his or her rights under this policy; or
- being the subject of professional misconduct by a student's graduate supervisor or other faculty or staff member.

3. Informal Procedures. University policy strongly encourages all students who believe they have a grievance to use all appropriate avenues for informal resolution before initiating a formal grievance. Students in CEE are encouraged to discuss the issue with the faculty or staff member with whom the problem has arisen. If a satisfactory solution is not forthcoming, the student should discuss the issue with his or her advisor, the director of graduate studies, or the head of the department, who shall attempt to find a resolution acceptable to both parties. This process must be initiated within 60 business days of the decision or behavior resulting in the grievance. The student may also consult with the Graduate College, the Office of the Dean of Students, the International Student and Scholar Services Office, or other sources before pursuing a formal departmental grievance. If it is not possible to come to a resolution at the informal stage, the student is informed in writing by the department head.

4. Formal Procedures. A student in the Department of Civil and Environmental Engineering may file a formal grievance with either the department head or directly with the Graduate College, as the student elects.

In CEE, the grievance committee will be formed from members of the Graduate Affairs Committee. The Graduate Affairs Committee consists of one appointed faculty representative from each of the seven areas of the department and two graduate students. The chair of the Graduate Affairs Committee will form an appropriate subcommittee of members of the Graduate Affairs Committee to serve as the grievance committee. This subcommittee will consist of at least two faculty members and in most cases, two graduate students. (The grievant may ask that no graduate students be included in the grievance committee; in that case a third faculty member will be added.) The identities of the grievance committee will be made known to all parties involved. If an informal departmental procedure was followed and the resolution was unsuccessful, then a formal grievance must be filed within 10 business days after the decision was made and both the grievant and the subject were informed that there was no resolution at the informal stage. If the grievant did not pursue an informal procedure, a formal grievance must be filed with the department head within 60 business days of the decision or behavior resulting in the grievance.

To initiate the Formal Procedures, the written grievance should indicate the parties involved, the date(s) of the alleged incident(s), the action or decision being contested, any applicable university, campus or unit policy, an explanation of why the action or decision is inappropriate, and the remedy sought. The head shall define the subject matter and scope of the issues related to the grievance in a written charge to the grievance committee. The primary parties involved, the grievant, the subject(s) and the grievance committee, shall receive a copy of the charge. Any participant to the grievance may challenge any member of the grievance committee if there is a perceived conflict of interest. The challenge must be made in writing to the head of the department within five business days of receipt of the charge. If the objection is reasonable, the head shall replace the person with one who meets the stated criteria. The head's decision is final.

The grievance committee's investigation shall include a review of written materials presented by both the grievant and subject and may seek information from the primary involved parties in writing or in person. The grievance committee determines if a hearing is to be held. During a hearing, each of the primary involved parties may make a brief opening statement, and then respond to questions from the committee. The primary involved parties may not question each other directly, but may pose questions through the committee chair. At the end of the hearing, each primary involved party may make a closing statement. As soon as practical after the filing of the grievance, the chair of the grievance committee shall report its recommendations in writing to the department head. The grievance committee's report shall contain:

- A copy of the Written Charge from the department head
- A summary of the grievant' s contentions and relief sought
- The response of the individual or department against whom/which the grievance was filed
- A general description of the investigative process
- A citation of relevant policies
- An explicit finding of fact based on the preponderance of the evidence with respect to each grievance included in the grievance committee's charge
- A listing of the evidence relevant to each finding
- An indication of whether there was a reasonable basis in fact and honest belief for the allegations in the investigated grievance
- A recommendation of appropriate redress for the grievant(s), if applicable and
- Any recommended changes in policies and procedures to minimize the probability of recurrence.

Copies of the committee report shall be provided to both the grievant and the subject(s). Either party may submit written comments to the department head concerning the report within five business days of receipt of the report.

As soon as practical following the receipt of the committee report and all written comments, concerning the report, the head shall determine the disposition of the case and communicate the decision to the parties in writing. If the head determines that the grievance has not been proved nor has any merit, the head will notify all parties that the grievance has been dismissed. If the head concludes that the grievance has been sustained and has merit, the head will proceed in accordance with the University statutes and relevant University rules and regulations. The head may, after consultation with appropriate campus officers, prescribe redress for the grievant. In addition, the head may initiate modifications of department policies or procedures. The head shall notify the relevant primary involved individuals in writing (grievant, respondent, grievance committee members) of actions taken.

5. Appeal. Within 10 business days of receipt of written notification of the head's determination, appeals may be made to the Graduate College as specified in the Graduate College grievance policy. This appeal can be based only upon demonstrated specific deficiencies in the application of this department grievance procedure to the student's grievance.

After completion of a grievance review and all ensuing related actions, the head shall return all original documents and materials to the persons who furnished them. A report of the nature of the grievance and the primary involved parties shall be forwarded to the Graduate College.

6. General Provisions. The head shall have the primary responsibility for administering the procedures detailed herein. All information and items furnished will be made available to the grievance committee. During the course of an investigation, the head will provide information about the status of the proceedings to the primary involved individuals. Subsequent to the grievance committee's reporting, the head will maintain a file of all documents and evidence, and is responsible for the confidentiality and the security of the file. The grievance file is subject to destruction on a date six years beyond the grievant' s time limit for completion of the degree. The head shall make the complete file available to the intake dean of the Graduate College on the appeal of a grievance outcome to the Graduate College.

7. Withdrawal of a Grievance. The grievant may submit a written request to withdraw the grievance at any time. The head shall decide whether to approve the request. If the withdrawal request is approved, the head shall notify the primary parties involved and the files shall be destroyed. If the withdrawal request is denied, the grievance shall continue to be processed to a conclusion according to the above procedures.

8. Other Requirements, Definitions, Standards, and Considerations. The departmental parties responsible for the implementation of this policy may consult University Legal Counsel at any time during the informal or formal processing of a grievance. All persons involved in administering these procedures will make diligent efforts to protect the reputations, privacy, and positions of all involved persons. These persons include those who file grievances, persons who are alleged in a grievance to have taken inappropriate actions or activities, and department administrators. All of the procedures and the identity of those involved should be kept confidential to the extent permitted by law. However, confidentiality regarding information other than the identity of the grievant need not be maintained if the grievance is found to be false and in particular if dissemination is necessary to protect the reputation of individuals or units falsely accused. Making public the fact that a grievance has been deemed false or unproved is not considered retaliation against the grievant. Protection of confidentiality does not preclude disclosures necessary to redress actions leading to a grievance.

The grievance committee's recommendations to the head shall be made on the "preponderance of evidence" standard. Any finding against an individual or department on the subject of the grievance must be supported by a preponderance of the evidence. It shall be a prime concern of all persons who implement this policy and these procedures to protect the academic freedoms fundamental to the academic enterprise. Among other things, this includes the professional judgments of student performance that are an essential part of the graduate education process.

Academic freedom, however, affords no license for the mistreatment of graduate students. The rights of the primary involved individuals shall be specified in the form of a written notice or letter from the head. The primary involved individuals have the following rights:

- To receive notice of the identity of the members of the grievance committee.
- To receive a written statement of the charge including the subject matter being considered by the grievance committee. If additional information emerges during the committee's evaluation that substantially changes the subject matter, the parties shall be informed promptly in writing.
- To submit statements in writing and to request to meet with the committee to present information and to request a hearing.
- To use a consultant, or another person, who may provide advice during the process. If a hearing is held, prior notice of the presence of a consultant must be given. If any party's consultant at any meeting is an attorney, all participants must be informed at least three business days prior to such a meeting. Any other primary involved party may request a delay of up to 5 business days to arrange for the presence of a consultant.
- To review and respond to the grievance committee's final report.

A conflict of interest is a significant professional or personal involvement with the facts or the parties to a dispute. Any participant, who has a conflict of interest in a dispute under this procedure, or a concern about a conflict on the part of another, shall report it to the head who shall take appropriate action. If the h ead has such a conflict, the head will inform the intake dean of the Graduate College who will, in consultation with the dean of the Graduate College, decide how to address the situation.

All procedures prescribed in this document should be conducted expeditiously. The head, for good cause, may extend any of the time periods and may make other reasonable alterations of these procedures, provided that the alteration does not impair the ability of a grievant to pursue a grievance or the respondent(s) named in the grievance to defend him/herself. Any alterations of these procedures must be communicated to all pertinent parties.

Withdrawal from the University by the grievant, or the termination of University employment of any of the subjects in a grievance, by resignation or otherwise, after initiation of procedures under this policy, shall not necessarily terminate these proceedings. Bringing unfounded charges in bad faith is a violation of this and the Graduate College grievance policy. If the grievance committee determines that the allegation(s) in the grievance or the testimony of any person was unfounded and motivated by bad faith, that finding shall be communicated by the head to the dean of the Graduate College. Such finding may be the basis for disciplinary action or other personnel decision in accordance with University rules and regulations.

Reviewed by Graduate College 09/15/2011

Appendix 2 – M.S. Degree Requirements and Procedures for the Ten Departmental Areas

MSCE Degree Requirements for Construction Materials, Geotechnical, and Transportation: Check with your advisor.

MSCE Degree Requirements for Structural Engineering:
Please refer to the structural engineering website for the most current requirements and procedures: http://structures.cee.illinois.edu

MSEE Degree Requirements for Environmental Engineering:

Please refer to the environmental engineering website for the most current requirements and procedures: http://environmental.cee.illinois.edu .

MSCE Degree Requirements for Water Resources Engineering and Science:

Please refer to the Water Resources Engineering and Science website for the most current requirements and procedures: http://hydro.cee.illinois.edu/

MSCE Degree Requirements for Construction Engineering and Management:

Students are required to complete 36 hours of graduate course work without a thesis, or 32 hours of course work with a thesis. At least 12 hours must be taken in the fields of construction engineering and management at the 400-level. At least three 500-level courses must be taken; at least 8 hours must be in the fields of construction engineering and management. The rest of the hours (electives) can be taken from related fields of construction engineering and management, including business administration, finance, architecture, and industrial engineering. No more than 4 hours of CEE 597 may be used towards the 500-level requirement. Students are expected to work closely with their program advisors to develop programs of study that will meet the degree requirements and the student's career objectives. All programs of study are subject to review and approval by the construction area advisors.

MSCE Degree Requirements for Sustainable and Resilient Infrastructure Systems Program:
Please refer to the SRIS website for the most current requirements and procedures: http://cee.illinois.edu/areas/sustainable-and-resilient-infrastructure-systems-program.

MSCE Degree Requirements for Energy-Water-Environment Sustainability Program:
Please refer to the EWES website for the most current requirements and procedures: http://cee.illinois.edu/areas/energy-water-environment-sustainability-program .

MSCE Degree Requirements for Societal Risk and Hazard Mitigation:
Please refer to the SRHM website for the most current requirements and procedures: https://cee.illinois.edu/areas/societal-risk-and-hazard-mitigation-program

Appendix 3 - Plan of Study

Plan of Study

Department of Civil and Environmental Engineering
Master of Science in Civil Engineering

The Plan of Study is a contract for the degree of Master of Science in Civil Engineering at the University of Illinois at Urbana-Champaign. All students admitted to pursue the M.S. degree in Civil Engineering are required to submit a Plan of Study.

The Plan of Study should be completed in consultation with an academic advisor in your area or program of study. It requires approval by the advising faculty member. The completed and signed Plan of Study should be submitted to your faculty advisor or area/program administrative coordinator, and also to Joan Christian in 1108 NCEL. Individual areas or programs may have a customized Plan of Study document that should be used in place of this form.

A revised program can be proposed at any time prior to graduation by submitting a new Plan of Study for approval. You will be eligible to graduate only when the courses you have successfully taken (along with any thesis requirements) match those listed on your approved Plan of Study.

_____
Student's Name (please type or print)

_____ _____
Student ID Number Anticipated Degree Date

_____
E-mail Address

_____

_____
Mailing Address

_____
Academic Advisor

Thesis Option (check one) ☐ Thesis ☐ Non-Thesis

Course Selections

Core Courses

Areas and Programs each have their own set of core courses required to complete the M.S. degree. A list of these for each area/program is available from your academic advisor.

If you elect not to take a required core course, please explain (e.g. indicate proficiency in that subject) on the reverse side under *Notes and Comments.*

Other Courses

The program, including cores courses, must total 36 hours (HR) of graduate credit for the non-thesis option and 32 hours of graduate credit (up to 8 of which are typically CEE 599M) for the thesis option. Graduate credit is only given for courses numbered in the 400 or 500 series. At least 12 hours of credit must be obtained for courses numbered in the 500 series, and eight of these twelve hours must be taken for grades in the major field. No more than four of these eight hours can be CEE 597 Independent Study.

Courses can be selected from a pre-approved list for your area/program. Proposed courses not on the pre-approved list must be justified on the reverse side of this form under *Notes and Comments* and are subject to approval by your academic advisor. Any courses in the 300 series or below taken for credit will count towards your GPA but not towards the graduate credit requirements.

Semester	Course Number	Credit (Hrs.)
	Total Credit	

Required Signatures

_____
Student Date

_____
Academic Advisor Date

Notes on filling out the Plan of Study

List any transfer courses by course number at offering institution (these courses must be approved, by petition, by the Graduate College). A brief description of these courses should be included on the reverse side under *Notes and Comments.* **This form must be filled out in ink.**

Return completed and signed forms to faculty advisor or area/program administrative coordinator, and a copy to Joan Christian in 1108 NCEL.

Appendix 4 – Graduate Course Requirements for
MS Track in "Data Science + Civil and Environmental Engineering"

Students shall take 9 courses (36 credits) in this non-thesis Master's track in CEE. All students must take the 3 required core courses in the Data Science track. For the remaining 6 courses, the students shall follow the recommended coursework from one of the CEE Technical Areas or Interdisciplinary Programs. A minimum of three 500-level courses (12 hours) is required.

1. Core Courses for Data Science in CEE (All three courses required):

- **CEE 492** **Data Science for CEE**
  Course description: Students will learn to leverage data to study CEE problems, identify patterns and make actionable insights. The course includes training in digital and computer tools (such as data processing, exploratory data analysis, spatial data, data visualization, distributed computing, and statistical modeling) with their applications to CEE issues.
- **CEE 498MLC** **Machine Learning for CEE**
  Course description: Students will learn the fundamentals behind advanced machine learning and learn how to use machine learning tools to solve CEE problems. Topics include regression, Bayesian inference, deep neural networks, scientific deep learning, and Gaussian Processes.
- **CEE 498ISL** **Infrastructure Sensing Lab**
  Course description: Students will learn basic strategies for experimental design, and gain experience working with a variety of CEE sensing techniques; with components in experimental design and approaches to terrestrial, field, and laboratory-based measurements and experiential learning to explore sensor types and technologies. The course will have modules on 4 sensing applications: (1) mechanics and materials, (2) water and environment, (3) transportation, and (4) construction.

2. Recommended Core Courses from *one* of the CEE technical areas below:

1. Construction Engineering and Management
2. Construction Materials
3. EES
4. EWES
5. Geotechnical
6. Structures
7. Transportation
8. WRES
9. SRIS
10. SRHM

Recommended coursework in each CEE Technical Areas or Interdisciplinary Program

A.1. Construction Engineering and Management (CEM) Core Courses

Course number	Course name	No of credit hours
CEE420	Construction Productivity	4
CEE421	Construction Planning	4
CEE422	Construction Cost Analysis	4
CEE5xx	Pick from CEM 500-level course list	4
CEE5xx	Pick from CEM 500-level course list	4
5xx	Free technical elective course	4

CEM 500-level course list:

CEE521	Building Information Modeling
CEE522	Visual Data Analytics
CEE524	Construction Law
CEE526	Construction Optmization
CEE528	Construction Data Modeling
CEE595	AI in Construction Seminar

A.2. Construction Materials (CM) Core Courses

Course number	Course name	No of credit hours
CEE401	Concrete Materials	4
CEE405	Asphalt Materials	4
CEE504	Infrastructure NDE Methods	4
CEE5xx	Pick from CM 500-level course list	4
5xx	Pick from data-driven engineering courses	4
4xx or 5xx	Free Technical elective course	4

CM 500-level course list:

CEE501	Construction Materials Characterization
CEE502	Advanced Cement Chemistry
CEE503	Construction Materials Deterioration

A.3. EES Core Courses

Course number	Course name	No of credit hours
CEE442	Env Eng Principles, Physical	4

CEE443 or 447	Env Eng Principles, Chemical / Atmos. Chemistry	4
CEE444	Env Eng Principles, Biological	4
CEE537	Water Quality Control Proc, I	4
CEE538	Water Quality Control Proc, II	4
5xx	Pick from data-driven engineering courses	4

A.4. EWES Core Courses

Course number	Course name	No of credit hours
CEE 493	CEE 493 Sustainable Design of Engineering Technologies	4
ENG 571	ENG 571 Theory of Energy & Sustainable Engineering	4
CEE592	Sustainable Urban Systems	4
5xx	Pick from data-driven engineering courses	4
4xx or 5xx	Free Technical elective course	4
4xx or 5xx	Free Technical elective course	4

A.5. Geotechnical Engineering Core Courses

Course number	Course name	No of credit hours
CEE483	Soil Mechanics and Behavior	4
CEE484	Applied Soil Mechanics	4
CEE5XX	Pick from Geotech 500-level course list	4
CEE5XX	Pick from Geotech 500-level course list	4
CEE5XX	Pick from data-driven engineering courses	4
4xx or 5xx	Free Technical elective course	4

Geotech 500-level course list:

CEE580	Excavation and Support Systems
CEE581	Dams, Embankments, and Slopes
CEE582	Consolidation of Clays
CEE585	Deep Foundations
CEE586	Rock Mechanics and Behavior
CEE587	Applied Rock Mechanics
CEE588	Geotechnical Earthquake Engineering
CEE589	Computational Geomechanics

CEE590	Geotechnical field measurements
CEE593	Tunneling

A.6. Structures Core Courses

Course number	Course name	No of credit hours
CEE470	Structural Analysis	(Typically taken in undergrad)
CEE471	Structural Mechanics	4
CEE462*	Steel Structures, II	Total of 8
CEE463*	Reinforced Concrete II	
CEE472*	Structural Dynamics I	
CEE570	Finite Element Methods	4
CEE5XX	Pick from Structures 500-level course list	4
5XX	Pick from data-driven engineering courses	4

**take 2 out of 3 of these courses in consultation with advisor*

Structures 500-level course list:

CEE562	Highway Bridge Design
CEE571	Computational Plates and Shells
CEE572	Earthquake Engineering
CEE573	Structural Dynamics II
CEE574	Probabilistic Loads and Design
CEE576	Nonlinear Finite Elements
CEE577	Computational Inelasticity

A.7. Transportation Core Courses

Course number	Course name	No of credit hours
CEE4xx or 5xx	Pick from a TE Subgroup course list	4
CEE4xx or 5xx	Pick from a TE Subgroup course list	4
CEE5xx	Pick from a TE Subgroup course list	4
CEE5xx	Pick from a TE Subgroup course list	4
5xx	Pick from data-driven engineering courses	4
4xx or 5xx	Free technical elective	4

TE Subgroup Course Lists:

Pavement and Facilities

CEE405	Asphalt Materials I
CEE406	Pavement Design I
CEE415	Geometric Design of Roads
CEE505	Transportation Soil Stabilization
CEE506	Pavement Design II
CEE508	Pavement Evaluation & Rehabilitation
CEE509	Transportation Soils

Systems

CEE416	Traffic Capacity Analysis
CEE418	Public Transportation Systems
CEE498TE	Transportation Economics
CEE512	Logistic Systems Analysis
CEE515	Traffic Flow Theory
CEE517	Traffic Signal Systems
CEE598UTM	Urban Transportation Models

Railroad

CEE408	Railroad Transportation Engr
CEE409	Railroad Track Engineering
CEE410	Railway Signaling and Control
CEE411	RR Project Design & Constr
CEE412	High-Speed Rail Engineering
CEE598RTD	Railway Terminal Design & Oper
CEE505	Transportation Soil Stabilization
CEE509	Transportation Soils

A.8. WRES Core Courses

Course number	Course name	No of credit hours
CEE4xx	Pick from WRES course list	4
CEE4xx	Pick from WRES course list	4
CEE4xx	Pick from WRES course list	4
CEE5xx	Pick from WRES course list	4
CEE5xx	Pick from WRES course list	4
5xx	Pick from data-driven engineering courses	4

WRES Course list

CEE434	Environmental Systems I
CEE450	Surface Hydrology
CEE451	Environmental Fluid Mechanics
CEE457	Groundwater
CEE534	Surface Water Quality Modeling
CEE535	Environmental Systems II
CEE550	Hydroclimatology
CEE551	Open-Channel Hydraulics
CEE552	River Basin Management
CEE553	River Morphodynamics
CEE554	Hydrologic Variability
CEE555	Mixing in Environmental Flows
CEE557	Modeling of Groundwater Flow and Solute Transport
CEE559	Sediment Transport

A.9. SRIS Core Coures

Course number	Course name	No of credit hours
CEE491	Decision and Risk Analysis	4
CEE493	Sustainable Design of Engineering Technologies	4
CEE592	Sustainable Urban Systems	4
5xx	Pick from data-driven engineering courses	4
5xx	Free Technical elective course	4
4xx or 5xx	Free Technical elective course	4

A.10. SRHM Core Courses

Students should take the 20-hr courses required by SRHM program plus one 500-level course from the data driven engineering course list.

List of Data-driven Engineering Courses

Data-driven courses in CEE

- CEE473 Wind Engineering
- CEE 491 Decision and Risk Analysis
- CEE498CM Computer Methods
- CEE 498LM Learning Methods for Civil Engineering
- CEE 528 Construction Data Modeling
- CEE 545 Aerosol Sampling and Analysis
- CEE 556 Hydrocomplexity
- CEE 590 Geotechnical field measurement
- CEE591 Reliability Analysis
- CEE 592 Sustainable Urban Systems
- CEE 598VSO Visual Sensing in Civil Infrastructure
- CEE 521 Building Information Modeling
- CEE598GW Globalization of Water

Data-driven courses in other departments

- CS 412 Introduction to Data Mining
- CS 424 Real-Time Systems
- CS 440 Artificial Intelligence
- CS 446 Machine Learning
- CS 450 Numerical Analysis
- CS 512 Data Mining Principles
- CS 519 Scientific Visualization
- CS 543 Computer Vision
- CS 547 Deep Learning
- CS 598 Machine Learning for Signal Processing
- ECE 410 Digital Signal Processing
- ECE 486 Control Systems
- ECE 490 Introduction to Optimization
- ECE 515 Control System Theory & Design
- ECE 534 Random Processes
- IE 410 Stochastic Processes & Application
- IE 411 Optimization of Large Systems
- IE 510 Applied Nonlinear Programming
- IE 511 Integer Programming
- GEOG 517 Geospatial Visualization & Visual Analytics
- GEOG 527 Geospatial Artificial Intelligence and Machine Learning
- GEOG 570 Advanced Spatial Analysis
- STAT 420 Methods of Applied Statistics
- STAT 431 Applied Bayesian Analysis
- STAT 448 Advanced Data Analysis
- STAT 525 Computational Statistics
- STAT 542 Statistical Learning

- MATH 564 Applied Stochastic Process (STAT 555)
- ENG 498: Interdisciplinary Methods in Research Computing

Appendix 5 – Graduate Course Requirements for
MS Track in "EM(MA)^T + Civil and Environmental Engineering"
Engineering Materials and Additive Manufacturing Technologies

A new Track to collaborate and attract top students with the excitement in 3D printing that requires technical knowledge in mechanics and materials.

Graduate Course Requirements for MS Degree in CE/EE

Students are required to take 5 core courses (20 credit hours) from the main three subjects below with at least one from each of the main subjects below. The remaining 4 courses (16 credit hours) are technical elective courses selected with advisor approval.

1) Mechanics (minimum 4 hours):
- CEE 471 Structural Mechanics
- CEE 498 Mechanics of Additive Manufacturing
- CEE 570 Finite Element Methods
- CEE 576 Nonlinear Finite Elements
- CEE 577 Computational Inelasticity
- CEE 598 Advanced FE Methods
- CEE 598 Theory of Heterogeneous Materials
- CEE 598 Const. Modeling of Eng. Mat.
- CEE 598 Structural Design Optimization

2) Materials Synthesis and Characterization (minimum 4 hours):
- CEE 401 Concrete Materials
- CEE 405 Asphalt Materials I
- CEE 501 Const. Mat. Characterization
- CHEM 522 Experimental Spectroscopy
- MSE 580 Diffraction Physics of Materials
- CEE 598 Advanced Bit. Materials
- CEE 503 Construction Material Deterioration

3) Physics and Chemistry (minimum 4 hours):
- MSE 457 Polymer Chemistry
- MSE 458 Polymer Physics
- CEE 502 Advance Cement Chemistry
- CEE 544 Advanced Surface Science

PhD Road Map
- Direct admit to PhD program is allowed.
- Continued coursework: 8 graded courses total beyond MS, 4 of the which must be at the 500 level.
- Students must enroll in the EM(MA)T seminar series every semester.
- Students must pass the Interdisciplinary Qualifying Exam (QE) for admission to PhD Candidacy in the EM(MA)^T program. The QE comprises a written part on topics from the three main subjects indicated above for the MS degree and an oral part on a research topic.
- Preliminary Exam to approve dissertation topic.
- Continue research full-time, attend conferences, write technical papers, complete dissertation.
- Take Final Examination on dissertation research.

Department of Civil and Environmental Engineering
The Grainger College of Engineering
University of Illinois at Urbana-Champaign
1114 Newmark Civil Engineering Laboratory
205 N. Mathews Ave.
Urbana, IL 61801

cee.illinois.edu

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