

WAYNE STATE
UNIVERSITY

COLLEGE OF ENGINEERING

CIVIL &
ENVIRONMENTAL
ENGINEERING
GRADUATE HANDBOOK

(REVISED 12/11/17)

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Purpose

The purpose of this handbook is to provide Civil and Environmental Engineering Graduate students at Wayne State University a quick and complete source of information and guidelines to their departmental curriculum requirements. It is the intent of the Department to revise this handbook on a regular basis, unless deemed necessary to revise it more frequently. **Always consult the Academic Advisor, Faculty Advisor, the Graduate Program Director, or the Graduate Bulletin if this handbook cannot provide you with the proper guidelines or if you have any doubt or concern about your curriculum beyond the scope of this handbook.** This handbook can be downloaded from the department web site, http://engineering.wayne.edu/cee/gr_civil_handbook.pdf

Mission

The Civil and Environmental Engineering Department (CEE) offers graduate programs at the master's and PhD levels.

Master's Program: The mission of the master's program is to prepare students for successful career paths in civil engineering disciplines through professional preparation and discipline-specific education.

Graduate engineers with an M.S. degree will:

- Demonstrate the skills and competency to function in, and ultimately lead, project teams;
- Analyze and solve complex and emerging engineering problems using newly developed approaches and methodologies;
- Communicate technical information to a range of audiences both verbally and in writing; and
- Demonstrate professionalism with a commitment to the highest standards of ethical principles

PhD Program: The mission of the doctoral program is to prepare students for leadership positions in civil engineering practice, research and teaching.

Graduate engineers with a Ph.D. degree will:

- Design and complete original research in their specialty area;
- Demonstrate the ability to lead project teams;
- Evaluate complex and novel engineering problems and derive solutions using original (nonstandard) approaches and methodologies;
- Communicate technical information to a range of audiences both verbally and in writing; and
- Demonstrate professionalism with a commitment to the highest standards of ethical principles.

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About CEE Graduate Study

The Department of Civil and Environmental Engineering at Wayne State University offers graduate students a challenging, state-of-the-art education in the analysis, design and management of civil engineering systems. Our program provides students with access to modern laboratories and experimental equipment, as well as extensive computer facilities for teaching and research activities. The Civil and Environmental Engineering Department has established a strong national reputation in terms of both its academic program and the research success of its faculty. A highly-qualified team of part-time faculty also participates in teaching, bringing a strong combination of practical experience, applied theory, and an awareness of important needs and emerging problems in government and industry, to a graduate program which is truly unique and committed to engineering excellence. It is our primary goal to provide our students with the tools for success, the knowledge base necessary for solving challenging engineering problems and for achieving long term career goals.

This handbook has been developed to provide graduate students in Civil and Environmental Engineering with a comprehensive understanding of the policies and regulations governing admission, academic standards, and student responsibilities for both the M.S. and Ph.D. programs. Each student should carefully review the document at regular intervals to insure that he/she is in compliance with specific requirements of the University, the College of Engineering, and the Department of Civil and Environmental Engineering. The handbook contains critical information to assist students in completing their degree requirements in a timely manner and in accordance with all appropriate rules and guidelines of the graduate program.

The CEE graduate program at Wayne State University has traditionally attracted students employed by local industries and government, who attend the program mostly part-time, as well as domestic and international full-time students. The program is designed to accommodate the needs of both full-time and part-time students, so a majority of graduate classes are offered in the evening. Typically, the full-time students participate in research including experimental work under faculty supervision while pursuing their graduate courses.

Admission

Master of Science: Admission to the M.S. program in Civil and Environmental Engineering admission is generally granted to applicants who have achieved an overall honor point average (HPA) of 3.0 in completing an undergraduate engineering degree from an institution accredited by the Accrediting Board for Engineering and Technology (ABET) or from a comparable foreign institution. In the event that the degree is in an engineering field other than civil and environmental engineering, the student may be required to complete a set of pre-requisite undergraduate courses before graduate credit may be accrued. In exceptional cases a student without an undergraduate engineering background may be admitted to the civil and environmental engineering graduate program. In such cases, significant undergraduate pre-requisite work will generally be required. GRE Scores are required for M.S. Admission; however exceptions may be granted by the department in special cases. Letters of Recommendation which are submitted with the online University application are optional, however they may be required by the CEE Department in certain circumstances.

If the applicants have an HPA slightly below 3.0., and weaknesses in background are identified, the student must complete a specified set of remedial courses with a grade of "B" or better in order to achieve regular status. Students not meeting these conditions of admission are excluded from the program.

Doctor of Philosophy: Admission to the Ph.D. program in civil and environmental engineering requires that the student's overall HPA be 3.0 or greater, and 3.2 over the final two years. Students who do not satisfy these minimum requirements will not be considered for admission to the program unless they have completed an M.S. degree in civil and environmental engineering with an HPA in courses taken for graduate credit which is not less than 3.3 (or equivalent). Admission requires an undergraduate engineering degree from an institution accredited by ABET or from a comparable foreign institution. Only regular admission may be granted to the Ph.D. program. GRE Scores are required with a minimum quantitative score in the 80th percentile. A graduate faculty from the department must agree to serve as academic advisor to the student at the time of admission.

If a student is admitted to the Ph.D. program directly after completing a B.S. degree and ultimately fails to meet all subsequent requirements for the Ph.D., he/she may transfer appropriate credits toward the M.S. degree program in civil and environmental engineering. A Change of Graduate Status Request form (https://gradschool.wayne.edu/phd/phd_change_of_status_form.pdf) must be submitted and approved by the Department Graduate Program Director and the Engineering Graduate Office.

Visit <https://gradschool.wayne.edu/> for more information about applying to WSU's Graduate Programs

Academic Standards

A graduate degree is evidence of scholarly achievement, academic excellence, critical and creative thinking abilities, the capacity to apply and interpret what has been learned, and proper use of the work of others. Continuation of graduate status is contingent on satisfactory scholarship with grades of "B" (3.0) or better.

Graduate students are required to earn at least a "B" (3.0) average to satisfy degree requirements. Students must achieve a grade of "B" or better in all core courses taken in their field of specialization (see subsequent descriptions of specialty fields and core courses). Up to eight hours of grades lower than "B" in non-core courses may be applied toward the graduate degree provided that such courses are offset by an equal number of credits of grades higher than "B" to assure a "B" average in all courses used to satisfy degree requirements. Students may be allowed to repeat a maximum number of two courses to improve their honor point average. Registering in the course for the second time must be approved by the student's academic advisor.

Twelve hours or more of grades lower than "B" will result in automatic termination of the student from the graduate program. These twelve hours include grades lower than "B" obtained in courses later repeated.

Specialty Fields

It is recommended that every student entering the Civil and Environmental Engineering graduate program declare a field of specialization before registering for courses leading toward a graduate degree. This information should also be specified on the application form submitted to the University Graduate School. The five specialty fields offered by the Civil and Environmental Engineering Department are briefly described below.

Environmental Engineering: This specialization focuses on applying scientific and engineering principles, theories, technologies, and methods to the protection and improvement of environmental quality and human health. Courses address the design and operation of water treatment and distribution systems, wastewater collection and treatment systems, industrial waste treatment, surface and groundwater hydrology, mathematical modeling of receiving water systems, environmental systems analysis, and land disposal of hazardous wastes. Faculty research projects include: assessment of water quality and environmental aesthetics in urban river systems, optimization of tributary monitoring and evaluation of contaminant loading within the Great Lakes region, numerical and physical modeling of the subsurface, development of advanced hazardous waste treatment technologies, containment characteristics of natural and synthetic liners, evaluation of the effect of compaction conditions on the unsaturated behavior of natural soil systems, and numerical analysis and prediction of the transport characteristics of mixed waste streams in groundwater systems. The Environmental Engineering specialization also includes sustainability engineering, which addresses energy production, resource usage, and waste disposal practices that minimize negative effects on the natural environment and future generations.

Geotechnical Engineering: Graduate courses in geotechnical engineering emphasize the analysis and design of building foundations, earthen structures, waterfront and offshore structures, tunnels, as well as various types of specialized foundations under different soil, rock, or groundwater conditions. Besides courses on fundamentals of geotechnical engineering, courses are offered in geosynthetics, waste disposal and management, and soil and groundwater remediation. The students often combine the geotechnical engineering specialization with coursework from structures, transportation, water and environmental engineering, or construction management.

Structural Engineering: Concerns the use of analysis and design methods to provide safe, functional, and efficient structures to support the civil infrastructure. Courses primarily address steel, concrete, and advanced composite building and bridge structures. Courses are design-focused as well as analysis-based, enabling design to current standards and solution of static and dynamic structural and solid mechanics problems. Recent faculty research projects include: live load models for bridge design and rating; shear behavior of prestressed concrete girders; externally-bonded CFRP; bridge life cycle costs; structural reliability assessment; development of advanced civil engineering materials; high capacity low cost lateral load resisting systems; super thin floors for mid-rise and high-rise construction; ultra-high performance concrete deck systems for movable bridges; shallow bridge superstructure systems.

Transportation Engineering: This specialty field focuses on the application of technology and scientific principles for the planning, design, operations, and management of transportation facilities to provide the safe and efficient movement of people and goods. Graduate courses offered in this area cover a broad range of topics including transportation planning, design, operations, technology, safety, economics, and pavement management. Past and ongoing research projects include: the application of Intelligent Transportation Systems (ITS), highway and transit safety evaluation, GIS applications in highway and transit, traffic calming strategies, travel demand models, bicycle and pedestrian travel, connected infrastructure and vehicles, work zone safety, and performance measurement using transportation data.

Construction Management: The program offered in this specialization includes course work on construction project management, estimating, scheduling, safety, quality, legal and professional aspects, Building Information Modeling (BIM) and construction methods. Additional courses from the Business School on accounting, marketing, and management, and systems oriented courses from Industrial and Manufacturing Engineering such as quality management and value engineering may be added supplement the program. Recent projects on construction include applications of artificial intelligence tools to construction safety, quality and productivity improvements, and service quality modelling and lean six sigma applications to improving facilities management and design processes at universities.

Each graduate student should meet with a faculty advisor within his/her declared field of specialization before formally registering for the first time. The faculty of the Department of Civil and Environmental Engineering and their respective fields of specialization are listed below:

Faculty Advisor Information

Environmental Engineering

Dr. Timothy Dittrich	(313) 577-3627	timothy.dittrich@wayne.edu
Dr. Shawn McElmurry	(313) 577-3876	s.mcelmurry@wayne.edu
Dr. Carol Miller	(313) 577-3842	cmiller@eng.wayne.edu
Dr. Yongli Zhang	(313) 577-9962	zhangyl@wayne.edu

Structural Engineering

Dr. Chris Eamon	(313) 577-3766	eo6111@wayne.edu
Dr. Fatmir Menkulasi	(313) 577-9950	fatmir.menkulasi@wayne.edu
Dr. Hwai-Chung Wu,	(313) 577-0745	hcwu@wayne.edu

Transportation Engineering

Dr. Tapan Datta	(313) 577-3803	tdatta@eng.wayne.edu
Dr. Stephen Remias	(313) 577-3854	sremias@wayne.edu

Construction Management

Dr. Emrah Kazan	(313) 9934369	ekazan@wayne.edu
Dr. Mumtaz Usmen	(313) 577-3608	musmen@wayne.edu

Department Chair

Dr. Mumtaz Usmen	(313) 577-3608	musmen@wayne.edu
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Graduate Program Director

Dr. Hwai-Chung Wu	(313) 577-0745	hcwu@wayne.edu
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Graduate Program Descriptions

MASTER OF SCIENCE IN CIVIL AND ENVIRONMENTAL ENGINEERING

The minimum requirements for the Master of Science degree are 32 credits under one of two degree plans approved by the College of Engineering:

Plan A: consists of twenty-four credit hours of approved course-work in combination with a minimum of eight credits of thesis. Students who elect the thesis option are required to file a Thesis Outline Approval form (https://engineering.wayne.edu/cs/master_form/master-thesis-outline-form.pdf) with their research advisor and the Department Graduate Program Director before writing the thesis. The signed form should be submitted to the Department Office. Final recommendation for thesis approval requires an oral defense of the material before a departmental committee consisting of at least 3 members; a minimum of 2 members must be from the Civil and Environmental Engineering. An industrial member with a Ph.D. may be a member of the thesis committee. The final defense form (http://engineering.wayne.edu/about/final_report-ms_final_doc.pdf) must be submitted to the Engineering Graduate Office. Information about the thesis style, format, and number of copies required can be found in the Graduate School section of the Wayne State University Graduate Bulletin. <https://gradschool.wayne.edu/masters/thesis>

Plan C: consists of thirty-two credits of course-work with the inclusion of appropriate core courses.

Plan of Work: By the time a student has completed 12 credit hours of Graduate Study, each graduate student must submit to the Department Office a Plan of Work (http://engineering.wayne.edu/cee/forms_and_documents/plan_of_work_cee.pdf) which lists all the courses to be taken for the M.S. degree. The Plan of Work must be approved by the student's academic advisor in his/her field of specialization and the Departmental Graduate Program Director. In preparing the Plan of Work, the student should carefully evaluate personal and professional objectives, as well as all degree and departmental requirements. After the Plan of Work has been filed with the Department Office, subsequent changes must be approved by the advisor and the Departmental Graduate Program Director and a new Plan of Work must be submitted to the Department Office.

CEE Credits: Students are required to complete a minimum 24 credits in the Civil and Environmental Engineering Department. Students are also required to complete a minimum number of credits in their specialty field. Some of the courses in the specialty fields are designated as core courses. The core courses cover fundamental principles in a specialty field and students must complete a minimum number of credits in these courses. Students must maintain a grade of "B" or better in all core courses. **At least two 7000-level courses must**

be taken in a student's specialty area (in most cases, core course requirements satisfy this criteria). Details for the required courses and credits for each specialty area are provided in the next section.

Students may be authorized to take up to four credit hours of directed study (CE 7990) and/or research (CE 7996) in any semester. The sum of CE 7990 and CE 7996 credits are limited to a maximum of four within any student's M.S. program. Students must communicate with their advisor, the instructor, and the departmental graduate program director to receive full approval prior to registration. Students who elect a directed study must submit a Directed Study Authorization form

(http://engineering.wayne.edu/cee/forms_and_documents/cee_graduate_directed_study_approval_form.pdf), which includes a description of the proposed directed study, with necessary signatures, to the departmental Graduate Program Director prior to registration.

Time limits: Master's degree and specialist certificate requirements must be completed within six years of the date of the first course applied toward the degree.

M.S. Coursework Requirements in Specialty Fields

Environmental Engineering

1. 24 credits in CEE Department with 16 credits in specialty field (12 of the 16 credits must be in core courses as indicated by an * below).

CE 5220*, CE 6130*, CE 6150*, CE 6190*, CE 5410, CE 6270*, CE 7190, CE 7220, CE 7260*, CE 7280, CE 7995 (River Assessment)

Courses recommended for the remaining 8 CEE credits are courses from above or CE 5510, CE 5520, CE 5810, CE 6580, CE 7530, CE 7640

2. Courses recommended for the remaining 8 credits (for 32 total) to complete master's degree requirements are: ChE 7200, ME 5300, ME 7300, ME 7310, IE 6210, IE 6270, BIO 5100, MAT 5070, MAT 5770, MAT 5830, MAT 5870. Alternatively, the student can select from the CEE courses listed in part 1 above.
3. Any deviations from the above must be approved by the student's advisor and must be included in the student's Plan of Work.

Structural Engineering

1. 24 credits in specialty field with 16 of the 24 credits in core courses (core courses are indicated by an *).

CE 5350*, CE 5370*, CE 6330*, CE 6340, CE 6370* or CE 6410*, CE 7070, CE 7300*, CE 7350, CE 7370, CE 7460

2. Any deviations from the above requirements will be granted in very special situations only, and need approval of all structures faculty.

Transportation Engineering

1. 24 credits in CEE Department with 16 credits in specialty field and 12 of the 16 credits in core courses (core courses are indicated by an *).

CE 5610, CE 6660, CE 7080, CE 7600*, CE 7620*, CE 7630*, CE 7640*, CE 7670*, CE 7995 (ITS)

2. Recommended courses outside of the specialty area are other graduate courses offered by the CEE department and the following:

IE 5560, IE 6210, IE 6260, IE 6270, IE 6430, IE 6470, IE 7240, IE 7250, IE 7270, IE 7430, IE 7520, IE 7710, IE 7720, ME 5000, ME 5010, UP 6320, UP 6420, UP 6510, UP 6520, MAT 5070, MAT 5100, MAT 5220, MAT 5230, MAT 5710, MAT 5780, MAT 6830.

3. Any deviations from the above requirements must be approved by the student's advisor and must be included in the student's Plan of Work.

Construction Management

1. 16 Credits in specialty field with 12 of the 16 credits in core courses (core courses are indicated by an *).

CE 5810, CE 6010*, CE6050*, CE 6060, CE 6880*, CE 7020*, CE 7830*, CE 7840, CE 7850, CE 7860, CE 7890*, CE 7995 (Quality Mgt.)

2. Recommended courses outside of the specialty area are other graduate courses offered by the CEE department and the following:

BA 6000, BA 6010, BA 6020, BA7000, ACC 7100, FBE 7992, ISM 7500, ISM 7510, MGT 7700, MGT 7840, MKT 7330, IE 5260, IE 6240, IE 7250, IE 7290, IE 7520, IE 7720

3. Any deviations from the above requirements must be approved by the student's advisor and must be included in the student's Plan of Work.

Geotechnical Engineering

MS students interested in graduate study with a major in geotechnical engineering must work with a graduate faculty advisor who will provide guidance on how to pursue 32 credits of coursework and research after preparing a Plan of Work that is approved by the Graduate Program Director and the Department Chairman.

List of Forms / M.S. Degree

A list of forms required to be completed for the M.S. degree is presented below. Hard copies of the forms are available electronically from the academic advisor, or via the website.

- Plan of Work Form
(http://engineering.wayne.edu/cee/forms_and_documents/plan_of_work_cee.pdf)
- Directed Study (CE 7900) and/or research (CE 7960) Forms (Request Form and Authorization Form) (http://engineering.wayne.edu/cee/forms_and_documents/cee_graduate_directed_study_approval_form.pdf)
- Engineering Graduate Office Final Report Form (only for "Thesis" option, Plan A) (http://engineering.wayne.edu/about/final_report-ms_final_doc.pdf)

DOCTOR OF PHILOSOPHY IN CIVIL AND ENVIRONMENTAL ENGINEERING

A minimum of ninety credits beyond the bachelor's degree is required for the Ph.D. degree. The distribution of these credits is as follows:

1. Twenty-eight credits of course work in the major (Civil and Environmental Engineering) beyond B.S.;
2. Thirty credits of dissertation direction;
3. Thirty credits, excluding Candidate Status semesters, in courses open only to graduate students (i.e., 7000 level or above).
4. Remaining credits may be coursework, directed study (CE 7990), research (CE 7996), or pre-dissertation research (CE 9990)
5. Any deviations from the above must be approved by the student's advisor. If the student has an approved POW and deviates from the POW, then the Grad School needs a revised POW.

Plan of Work: All prospective doctoral students are required to submit a Plan of Work indicating their anticipated schedule of course work during the Ph.D. program. The Plan of Work should be prepared in consultation with the student's academic advisor. After written approval is received from the advisor and the Departmental Graduate Program Director, the

Plan of Work should be submitted to the Graduate School for approval before the student has completed forty graduate credits (including the master's degree work). Any subsequent changes in the plan must be approved by the student's advisor and a new Plan of Work form must be submitted to the Ph.D. Programs Office of Graduate School for approval.

Residence: The Ph.D. requirement of one year of residence is met by completion of at least six graduate credits in course work, exclusive of dissertation or other research, in each of two successive semesters. The Spring/Summer semester may be excluded from the definition of successive semesters. Additional residence requirements may be imposed as appropriate.

Advisor: At the time of admission into the Ph.D. program, each student is assigned an academic advisor by the Department. This faculty member may serve as the student's academic advisor throughout his/her program, or the student may subsequently choose another faculty member to serve as his/her academic advisor based upon mutual research interests and consent. The academic advisor represents the Department in helping plan the student's program, and is responsible for recommending candidacy, guiding the student's research, chairing the doctoral committees, arranging for the doctoral examinations, and certifying to the Graduate School that degree requirements have been fulfilled.

Doctoral Committees: The doctoral committees include the members of Preliminary Exam Committee and the Dissertation Committee.

The Preliminary Exam Committee must consist minimally of three members from the major department including the student's advisor. This committee administers the Preliminary Exam.

The Dissertation Committee must consist minimally of three members from the major department and one extra-departmental member. The expertise of the extra-departmental member must be appropriate to the student's dissertation work. In the case of co-advisors from the same department, the number of major departmental members shall be increased to four. Any changes in the committee structure requires the approval of the Graduate School. The Dissertation Committee administers the Qualifying Exam and Dissertation Prospectus Defense.

Preliminary Exam: Doctoral students are required to pass a preliminary exam (written and oral) prior to scheduling their qualifying exam. The preliminary exam is a requirement of the Civil and Environmental Engineering Department. This exam covers the student's competence in his/her field of specialization (i.e., environmental engineering, structural engineering, transportation engineering, or construction management). The preliminary exam should normally be scheduled within the first three semesters of the student's doctoral program, but no later than the completion of all the graduate course work. The preliminary exam is administered by the student's advisor and the Preliminary Exam Committee. The performance of the student in the preliminary exam is used by the committee to determine competence of the student to continue in the doctoral program. The Preliminary Exam Committee can directly find the student competent to continue in the program or the

committee can suggest additional course work and modifications to the original Plan of Work.

If the Preliminary Exam Committee determines that the student has failed the preliminary exam, the committee will either recommend that the student be terminated from the Ph.D. program or that a second exam be scheduled within one year of the first exam. In the latter case, the committee may recommend that the student successfully completes one or more graduate courses prior to taking the second exam to improve his/her skills in a particular area. Failing the preliminary exam a second time will automatically terminate the student from the Ph.D. program. The results of the preliminary exam are certified in the departmental Preliminary Exam Report Form

(https://engineering.wayne.edu/cee/forms_and_documents/phd_report_on_preliminary_examination_form.pdf) which is approved by the members of the Preliminary Exam Committee and the Chair of the Department.

Qualifying Exam and Dissertation Prospectus Defense: The qualifying exam and dissertation prospectus defense is administered by the Dissertation Committee, and emphasizes the student's proposed dissertation research (prospectus). In the Department of Civil and Environmental Engineering, the prospectus meeting fulfills the Oral Examination requirement. At least one week before the prospectus meeting, the student should submit the Prospectus and Record of Approval form with the Dissertation Committee names to the departmental graduate director. The graduate director shall verify that at least two members of the examining committee hold graduate faculty appointments before the exam can proceed. At the end of the exam, the Prospectus and Record of Approval form, Recommendation for Candidacy Status form, and Disclosure Form for Conflicts of Interest should be used to transmit the result to the Graduate School. If the committee determines that the student has not passed all parts of the written and oral examinations, the committee must make recommendations as to admitting the applicant to a second examination and specify any additional work that should be completed prior to such an examination. If the committee certifies that the student has failed the oral part of the examination, a second examination may not be held until at least one semester has elapsed, but must be held within one calendar year following the first examination. The second examination is considered final and failing the second exam will automatically terminate the student from the Ph.D. program.

Dissertation Registration and Outline: The Dissertation should be given consideration early in the program, but generally a student will not be permitted to register for dissertation direction (CE 9991 or higher) credits until he/she has fulfilled all requirements for advancement to Ph.D. candidacy. In some cases, with the approval of the student's advisor and the Graduate School, a Ph.D. applicant may be allowed to register for up to 7.5 credits of dissertation direction before admission to candidacy.

Effective 2009, the permission to enroll in CE 999x classes comes directly from the Graduate School. Students are required to send an email to phdstudents@wayne.edu, with their name, ID number, class they would like to register for & CRN (ex. CE 9991, 12345), and semester.

Candidacy: A Ph.D. applicant will be advanced to the rank of Ph.D. candidate when he/she submits an approved Plan of Work, successfully completes the preliminary and qualifying examinations and submits and receives the Graduate School's approval on the Prospectus and Record of Approval form, the Recommendation for Candidacy Status form, and Disclosure Form for Conflicts of Interest.

Dissertation Public Lecture Presentation - Defense: The dissertation presentation and defense is administered by the Dissertation Committee. The dissertation format and appearance must be acceptable to the Graduate School before the Dissertation Public Lecture Presentation-Defense is authorized. In addition, each committee member must have certified, in writing, that the dissertation has been read and approved for a Public Lecture Presentation-Defense.

The dissertation shall be formally presented in a lecture in which the candidate shall state the methodology, research, and results of the investigation. Conducted by the candidate's Dissertation Committee, this final lecture shall be publicized to the entire academic community in advance by the student and research advisor. In the discussion following the presentation of a dissertation lecture, other matters which the committee deems relevant may be introduced.

Two final signed copies of the dissertation and the Final Defense form are to be submitted to the Graduate School within ten calendar days after the Dissertation Public Lecture Presentation-Defense. The Ph.D. degree will be certified only upon receipt of these forms.

Graduation: Each candidate for a degree or certificate must file an Application for Degree no later than the last day of the final registration period for the semester in which he/she expects to complete the requirements for the degree. If an application for a degree was filed for a previous term in which the student did not graduate, a new application is necessary.

Specific details pertaining to the Ph.D. course-work and other requirements are given in the **Handbook for Doctoral Students and Advisors and the Graduate Bulletin**. These documents which are available from the Graduate School should be carefully reviewed by all doctoral students.

<https://gradschool.wayne.edu/policies/>
<https://gradschool.wayne.edu/policies/all-forms>

List of Forms / Ph.D. Degree

A list of forms required to be completed for the Ph.D. degree is presented below. Hard copies of the forms are available from the Graduate School. Please visit <https://gradschool.wayne.edu/policies/all-forms> for information on obtaining these forms.

- Change of Committee, Doctor of Philosophy
- Change of graduate status request
- Conflict of interest form

- Dissertation and thesis format guidelines
- Doctoral dissertation: Prospectus and record approval
- Final report dissertation defense
- Plan of work
- Petition and authorization for directed study
- Recommendation for candidacy status
- Time extension request
- Transfer of credit
- Preliminary exam approval - Use the below link
https://engineering.wayne.edu/cee/forms_and_documents/phd_report_on_preliminary_examination_form.pdf

Checklist for the Ph.D. Degree

Following is a chronological list of degree requirements to be used by students and their academic advisors in tracking progress within the Ph.D. program and ensuring that all requirements of the University, College, and Civil and Environmental Engineering Department are met in a timely manner.

1. Student: Completes Plan of Work and submits it to the Department and Graduate School for approval.
2. Student: Arranges with CEE Department to take Preliminary Exam.
3. Student: Arranges with CEE Department to take Qualifying Exam and Dissertation Prospectus Defense.
4. Graduate School: Advances student to Candidacy after approval of the Prospectus and Record of Approval form and the Recommendation for Candidacy Status form.
5. Student: Prepares dissertation.
6. Student: Files application for degree not later than the last day of registration for the term in which he/she expects to graduate.
7. Student: Receives committee approval for the dissertation defense and Graduate School approval of dissertation format.
8. Department: Arranges date, time, and place of final oral and informs the Graduate School one week in advance.
9. Student: Presents Public Lecture Presentation - Defense.
10. Student: Submit signed copies of the dissertation and the Final Defense form to the Graduate School
11. Department: Submits dissertation grade changes to the Graduate School.

CEE Graduate Course Descriptions

5220 Environmental Chemistry. Cr. 3

Fundamentals of aqueous chemistry for environmental engineers and scientists. Basic chemistry, equilibria, kinetics and thermodynamics; includes acid/base reactions,

precipitation/dissolution, oxidation/reduction reactions and partitioning. Material fee as indicated in the Schedule of Classes (B)

5230 Water Supply and Wastewater Engineering. Cr. 4

Prereq: CE 4210. Analysis and design of water supply and wastewater treatment systems; water distribution systems; treatment of municipal water supplies, including sedimentation, softening, filtration and disinfection; design of sanitary and storm sewers; primary, secondary and tertiary treatment plant design; sludge handling. Material fee as indicated in the Schedule of Classes (Y)

5350 Introduction to Structural Dynamics. Cr. 4

Prereq: CE 4400. Dynamic properties of structures. Modeling of dynamic loads. Structural response to dynamic loading. Structural design requirements for dynamic loads. Fundamental techniques of dynamic system analysis. (W)

5370 Finite Element Analysis Fundamentals. Cr. 4

Prereq: CE 4400. Matrix structural analysis, discretization of continuous structural systems, stress analysis. Commercial finite element software preprocessing for developing finite element models; post-processing for evaluating analysis results. (F)

5410 Energy, Emissions, Environment (E3) Design Cr. 4

Provides students the tools to uncover the relation between energy consumption and energy generation and optimize processes to take most advantage of low emitting energy options. Exposes students to design tools and methodologies from a diverse group of sources including US EPA, DOE, EIA, and the latest in emerging research. (F)

5510 Geotechnical Engineering I. Cr. 4

Prereq: CE 4510. Site investigation, site improvement, bearing capacity and settlement of shallow foundations, axial capacity and lateral deflection of deep foundations, design of conventional earth retaining walls, and basics of slope stability analyses. (F)

5520 Geotechnical Engineering II. Cr. 4

Prereq: CE 4510. Lateral earth pressure theories, design of conventional earth-retaining walls and of reinforced earth walls, anchored sheet-pile walls and cofferdams, fundamentals of soft-ground tunneling, two- and three-dimensional slope stability analyses, and static design of earth dams. (B)

5610 Highway Design. Cr. 4

Prereq: CE 4640. Application of standards, theory and practice in design of streets and highways. Design of streets and highways including cross section elements, shoulder and roadside features. Pavement design and rehabilitation work. (Y)

5810 Legal Aspects of Engineering and Construction. Cr. 3

Business of contracting, construction, liabilities of owner, architect, engineer and contractor. Rights in land, boundaries and foundations. Case studies. Material fee as indicated in the Schedule of Classes (F)

5830 Business of Engineering. Cr. 3

Prereq: C E 4850. Defining the engineering company, creating the organization, support services, business development, project management, scheduling, budgeting and profitability, operations, financial management and risk management. (T)

5995 Special Topics in Civil Engineering I. Cr. 1-4

Prereq: consent of chairperson. Topics to be announced in Schedule of Classes . (I)

6010 Introduction to Construction Management. Cr. 3

Prereq: CE 4850 or consent of instructor. An introduction to the organization and management of design and construction firms. Organizational and managerial theories. Problems of organization management, operation and control of engineering systems, case studies. Material fee as indicated in the Schedule of Classes. (W)

6050 Construction Cost Estimating. Cr. 3

Prereq: CE 4850. Estimating construction costs of engineering projects including materials, man-hours, equipment and overhead. Emphasis on construction equipment, including productivity and planning. Bidding and bid documents. (B)

6060 Construction Techniques and Methods. Cr. 3

Prereq: CE 4450. Construction techniques and methods for excavation, foundations, concrete, wood, steel, masonry, heavy construction, wastewater treatment plants, highways and roads, high rise structures, bridges, and tunnelling projects. (B)

6130 Open Channel Hydraulics. Cr. 4

Prereq: CE 3250. Principles and practices of pavement management at network and project level: serviceability, pavement design models, economic analysis and priority modeling (B)

6150 Hydrologic Analysis and Design. Cr. 4

Prereq: CE 6130. Principles of surface water hydrology and their application for evaluation of floods and the design of surface runoff control system; watershed characteristics; design storms and SCS methods; unit hydrographs; hydrologic models; application of computer methods. (B)

6190 Groundwater. Cr. 4

Prereq: CE 3250. Historical background, aquifers and aquitards, saturated and unsaturated flow, sources of ground water contamination, artificial recharge of ground

water, development of ground water basins and efficient use of ground water resources. (Y)

6270 Sustainability Assessment and Management. Cr. 3

Prereq: CE 4210. Sustainability assessment and management for engineering design and development; theoretical, regulatory, and practical implications; Detroit and global applications. (Y)

6330 Advanced Structural Analysis. Cr. 4

Prereq: CE 4410. Effect of axial loads on stiffness of flexural members. Buckling of trusses and rigid frames. Matrix method of analysis. Complex structures. Computer applications. (F)

6340 Bridge Design and Evaluation. Cr. 4

Prereq: CE 4420. Concepts, procedures, methods of design and condition evaluation for modern highway bridges, according to current specifications. Entire system is covered, including superstructure, substructure, and their connections. (B)

6370 Advanced Reinforced Concrete Design. Cr. 4

Prereq: C E 4420. Theory and design of two-way slabs, footings, retaining walls, shear walls, and composite beams using ultimate strength design. Precast and prestressed concrete fundamentals. (W)

6410 Advanced Steel Design. Cr. 4

Prereq: C E 4420. Advanced topics of structural steel design: thin walled rolled and built-up members, beam columns, lateral torsional buckling, steel fatigue design, connection details. Steel design project. (W)

6580 Geoenvironmental Engineering I. Cr. 4

Prereq: CE 4510. Properties and test methods for natural and synthetic materials used in landfills; analysis of chemical interactions, flow mechanisms, stability and settlement for the design of landfill components. (Y)

6660 Pavement Management Systems: Principles and Practices Cr. 4

Prereq: CE 4640. Principles and practices used in pavement management systems, including pavement serviceability, pavement design, priority programming. (Y)

6880 Building Information Modeling (BIM). Cr. 3

Prereq: CE 3010. Lectures, hands-on demonstrations and lab exercises to familiarize students with concepts and tools in Revit Architecture 2010 software; how software integrates 3D and 2D modeling. (B)

6910 Pharmaceutical Waste: Environmental Impact and Management. Cr. 2-3

Course designed for advanced professional and graduate students with sufficient chemistry and/or biological sciences background who are interested in the environmental impact, management, and regulation of waste pharmaceuticals as emerging issues. (Y)

6991 Internship in Industry. Cr. 1-4.

Prereq: Department Permission. Written report describing internship experience.

7020 Construction Safety. Cr. 4

Prereq: CE 6010 or consent of instructor. Safety problems in the construction industry and their technical and managerial solutions, construction accident and failure analysis and control. Safety program design and implementation with TQM integration. (Y)

7070 Risk and Reliability in Civil Engineering. Cr. 4

Uncertainty in civil engineering practice (e.g., loads, traffic, water demand, construction quality). Reliability theory based on probabilistic and statistical methods. Reliability-based engineering design and decision making. (B)

7080 Civil Engineering Research Methods Cr. 3

Methods of data collecting and statistical analysis in context of civil engineering. Applications of advanced statistical analysis techniques, theory, discussion of methodological limitations (B)

7190 Groundwater Modeling. Cr. 4

Prereq: CE 6190. Analytical and numerical models of groundwater hydraulics and contaminant transport. Application of theoretical material developed in C E 6190. Case studies of model applications to real field problems. (Y)

7220 Industrial Waste Treatment. Cr. 4

Prereq: C E 4200 or consent of instructor. A study of the sources of specific industrial waste waters and their treatability by physical, chemical and biological processes, including the industries' obligation in the prevention of stream pollution. Problems and solutions involved in combined treatment of industrial and domestic waste waters. Material fee as indicated in the Schedule of Classes (B)

7260 Surface Water-Quality Modeling and Management. Cr. 4

Prereq: CE 4210 or consent of instructor. Principles and mechanisms governing the rate and transport of conventional and toxic pollutants in natural water; mathematical modeling of water quality in surface water systems; model applications for managing waste loads in lakes and rivers. (I)

7280 Applied Environmental Microbiology. Cr. 3

Provides knowledge of microbiology, roles and relations of microorganisms to the environment. Topics include practical applications of environmental microbiology to environmental issues including water treatment, biodegradation and bioremediation of environmental pollutants, production of alternative fuels, and emerging environmental concern. Special consideration will be given to water treatment and microbe-mediated cycling of organic materials (i.e. pollutants) in a variety of natural and engineered environment

7300 Advanced Structural Mechanics. Cr. 4

Prereq: CE 6330 or consent of instructor. Theory of bending and torsion of bars, beams on elastic foundations. Introduction to theory of thin plates. Linear elastic fracture mechanics, application to brittle solids. (F)

7460 Advanced Composite Materials for Civil Infrastructure. Cr. 4

Infrastructure problems. Advanced fiber reinforced plastics, including applications in primary/secondary and marine structures, and in rehabilitation. High performance fiber reinforced concrete. Controlled composite properties via composite design. Review of composite analysis and failure criteria based on micromechanics and laminate theory. (B)

7500 Engineering Properties of Soils. Cr. 4

Prereq: CE 5510, 5520, or consent of instructor. Overview of experimental methods in geotechnical engineering, instrumentation and data acquisition methods, statistical analysis of test data, tests and theories for settlement predictions, tests and theories for hydraulic conductivity determination, tests and theories for static and cyclic stress-strain-volume change behavior of soils. (B)

7530 Advanced Soil Mechanics. Cr. 4

Stress-strain and volume-change behavior of sands and clays for both drained and undrained loading conditions, to gain insight in mechanical behavior of foundation soils.

7550 Geosynthetics Engineering. Cr. 4

Fundamental principles for testing, design, and construction of geosynthetics in civil engineering applications. (B)

7580 Environmental Remediation. Cr. 4

Prereq: C E 4510 or equiv. or consent of instructor. Site assessment; soil and groundwater investigation for remediation; application of remediation technologies; legislation related to remediation. (Y)

7600 Highway Safety and Risk Management. Cr. 4

Safety aspects of streets and highways; planning, design, implementation and evaluation of highway safety improvement projects and programs. Highway risk analysis and risk management systems. Material fee as indicated in the Schedule of Classes (B)

7620 Traffic Engineering Control and Operation. Cr. 4

Traffic flow theories, macroscopic and microscopic models of traffic control, statistical analysis; design and application of intelligent transportation systems on traffic flow characteristics; evaluation. Material fee as indicated in the Schedule of Classes (Y)

7630 Urban Transportation Planning. Cr. 4

Planning and analysis of urban transportation, travel demand models, land use planning and public transportation; household and origin-destination survey techniques; and demand elasticities multicriteria evaluation. Material fee as indicated in the Schedule of Classes (F)

7640 Economic Analysis in Transportation Systems. Cr. 4

Application of engineering economy and price theory in optimization of transportation systems; analysis of congestion costs, externalities, primary and secondary costs and benefits; evaluation of alternatives and completed projects and programs. Material fee as indicated in the Schedule of Classes (Y)

7670 Advanced Traffic Signal Systems. Cr. 4

Analysis and design of traffic signal systems. Hardware, communication and detection systems associated with microcomputer-based signal systems. Coordinated signal systems. (B)

7830 Construction Planning and Scheduling. Cr. 3

Prereq: CE 6010 or consent of instructor. Planning and scheduling of construction projects, project networks and critical path methods, resource levelling, use of Primavera software. (Y)

7840 Facilities Management. Cr. 3

Prereq: CE 6010 or consent of instructor. Buildings and grounds operations and maintenance, planning design and construction, facilities economics and financing, real estate administration, environmental health and safety, health issues. (W)

7850 Construction Contract Administration. Cr. 3

Prereq: CE 6010. Project documentation; project setup and contract directory development; adding new contracts; purchase orders; recording materials deliveries; producing daily reports; preparing minutes of meetings; log submittals and handling correspondence; tracking contracts and costs, setup and preparing progress payment requisitions, managing claims and change orders.

7860 Construction Accounting and Financial Management. Cr. 3

Prereq: CE 6010. Construction financial management, construction accounting systems, analysis of financial statements, monitoring and controlling construction costs, managing overhead costs, markup, profit center analysis, cash flows for construction projects, financing, making financial decisions

7890 Integrated Construction Project Management. Cr. 3

Prereq: CE 6010. Construction project management framework, construction project integration, project scope management, time management, cost management, quality management, procurement management, risk management, communication management.

7990 Directed Study. Cr. 1-4 (Max. 6)

Prereq: written consent of adviser, chairperson and engineering graduate officer for master's students; written consent of adviser, chairperson and Dean of Graduate Studies for Ph.D. students. (T)

7995 Special Topics in Civil Engineering II. Cr. 1-4

Prereq: consent of instructor. A consideration of special subject matter in civil engineering. Topics to be announced in Schedule of Classes. (I)

7996 Research. Cr. 1-4 (Max. 6)

Prereq: consent of adviser and chairperson. (T)

8999 Master's Thesis Research and Direction. Cr. 1-8 (8 req.)

Prereq: consent of adviser. (T)

9990 Pre-Doctoral Candidacy Research. Cr. 1-8 (Max. 10)

Prereq: consent of department. For Ph.D. program applicants. Offered for S and U grades only. Research in preparation for doctoral dissertation. (T)

9991 Doctoral Candidate Status I: Dissertation Research and Direction. Cr. 7.5

Prereq: consent of dissertation adviser; Ph.D. candidate in department. Required in academic-year semester following advancement to Ph.D. candidacy. Offered for S and U grades only. (T)

9992 Doctoral Candidate Status II: Dissertation Research and Direction. Cr. 7.5

Prereq: consent of dissertation adviser; CE 9991. Required in academic-year semester following 9991. Offered for S and U grades only. (T)

9993 Doctoral Candidate Status III: Dissertation Research and Direction. Cr. 7.5

Prereq: consent of dissertation adviser; CE 9992. Required in academic-year semester following 9992. Offered for S and U grades only. (T)

9994 Doctoral Candidate Status IV: Dissertation Research and Direction. Cr. 7.5

Prereq: consent of dissertation adviser; CE 9993. Required in academic-year semester following 9993. Offered for S and U grades only. (T)

9995 Candidate Maintenance Status: Doctoral Dissertation Research and Direction. Cr. 0

Prereq: consent of dissertation adviser; completion of 30 credits in CE 9999, or 9991-9994. Offered for S and U grades only. (T)