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 Officer, 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 mission of the Civil and Environmental Department is to provide high quality, state-of-the-art educational and research programs. The Department strives for excellence in its academic programs, its research endeavors, and its university, community and professional service activities. The program is designed to prepare our graduates for success in their immediate, as well as long-term, professional careers as practitioners, for obtaining a professional license, and for pursuing advanced studies and life-long learning

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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 and design of civil engineering systems. Our program provides students with access to modern laboratories, testing machinery 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.

The civil and environmental engineering graduate program at Wayne State University has traditionally attracted many students employed by local industries and government. This program is designed to accommodate the needs of both full-time and part-time students. For this reason, a majority of graduate classes are offered in the evening. Alternatively, full-time students have the opportunity to participate in research and experimental work with the faculty while pursuing their graduate courses.

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 obligations 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.
Admission

Master of Science: Admission to the M.S. program in Civil and Environmental Engineering may be granted on a regular or qualified basis. Regular 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. Only in exceptional cases will a student without an undergraduate engineering background be admitted to the civil and environmental engineering graduate program. In such cases, significant undergraduate pre-requisite work will be required. **GRE Scores are not required for M.S. Admission. Also, 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.**

Qualified or probationary admission may be granted to students with an HPA below 3.0. In such cases the student must complete a specified set of 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 only required if the candidate did not graduate from an ABET accredited undergraduate program. If GRE scores are required, then a math score in the 80th percentile will be required.
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.

Visit http://gradschool.wayne.edu/future/ 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 must 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**: Studies in this specialization focus on engineering principles, theories, and methods pertaining to the understanding and protection of our natural environment. 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, 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.

**Geotechnical Engineering**: Graduate courses in geotechnical engineering emphasize the design and analysis of building foundations, dams, and natural slopes, waterfront and offshore structures, tunnels, as well as various types of machine foundations under different soil, rock, or groundwater conditions. In addition, courses are offered in geosynthetics engineering and waste disposal facilities. Geotechnology for soil and groundwater remediation is also included in the curriculum. Research projects in geotechnical engineering include: computer applications for control of static and dynamic laboratory tests with automatic data acquisition and reduction, development of new cyclic testing devices to simulate field conditions, studies of static and dynamic soil structure interaction as well as static and dynamic constitutive laws for soils.
**Structural Engineering:** Courses in the structural engineering specialty area address the analysis and design of steel and concrete structures under a variety of loading conditions (both static and dynamic). Recent research projects include: nondestructive test methods for assessing concrete quality and deterioration models for civil infrastructure. Additional research investigations focus on a variety of topical and challenging engineering problems such as: assessment of existing structures, design of structures utilizing artificial intelligence, probabilistic pattern recognition for bridge inspection, effects of truck weights on bridge network costs, monitoring bridges globally using laser radar system, and development of advanced civil engineering materials for general construction as well as infrastructure retrofit.

**Transportation Engineering:** This specialty field focuses on planning, design and analysis of transportation facilities for the safe and efficient movement of people and goods. Graduate courses offered in this area cover a broad range of topics including planning, design, safety, economics, pavement management, and risk management. Past and ongoing research include: highway and transit safety evaluation, highway risk management, GIS applications in highway and transit, transit vehicle replacement strategies, railroad grade crossing safety, traffic calming strategies, ITS applications on highway and transit operation, transit management information systems, transit seat belt, transit wheelchair lifts, and travel demand models.

**Construction Management:** The program offered in this specialization includes course work on construction project management, estimating, scheduling, safety, legal and professional aspects, and specifications. 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 complement the program. Recent projects on construction include: safety and quality attitudes of carpenters; workforce development for the construction industry; and improvement of the operations of an owner managed construction program.

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:
Faculty Advisor Information

**Environmental Engineering:**
Dr. Carol Miller, (313) 577-3842  cmiller@eng.wayne.edu
Dr. Shawn McElmurry (313) 577-3876  s.mcelmurry@wayne.edu
Dr. Yongli Zhang  zhangyl@wayne.edu

**Structural Engineering:**
Dr. H.C. Wu, (313) 577-0745  hcwu@eng.wayne.edu
Dr. Chris Eamon (313) 577-3766  eo6111@wayne.edu

**Transportation Engineering:**
Dr. Tapan Datta, (313) 577-3803  tadata@eng.wayne.edu

**Construction Management:**
Dr. Mumtaz Usmen, (313) 577-3608  musmen@wayne.edu

**Department Chair:**
Dr. Joseph Hummer (313) 577-3790  joseph.hummer@wayne.edu
Graduate Program Descriptions

A. 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 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 with their research advisor, the Department Graduate Program Officer, and the Engineering Graduate Office before writing the thesis. Final recommendation for thesis approval requires an oral defense of the material before a departmental committee consisting of four faculty members, including the advisor and one faculty member from outside the Department. 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.

**Plan C**: consists of thirty-two credits of course-work.

**Plan of Work**: By the time a student has completed 12 credit hours of Graduate Study, each graduate student must submit to the College a Plan of Work (approved by the G.P.O. and faculty advisor) which lists all the courses to be taken for the M.S. degree. The Plan of Work must be approved by the students academic advisor in his/her field of specialization and the Departmental Graduate Program Officer. 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 College Graduate Officer, subsequent changes must be approved by the advisor or the Departmental Graduate Program Officer and a new Plan of Work must be submitted to the College.

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).** Exceptions to
these requirements must be approved by the student's advisor and must be included in the student's Plan of Work. Details for the required courses and credits for each specialty area are provided in the list below.

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 officer to receive full approval prior to registration. Students who elect a directed study must submit a Directed Study Authorization form, which includes a description of the proposed directed study, with necessary signatures, prior to registration. In addition, the student must complete the departmental Directed Study Request form and submit a copy to the departmental Graduate Program Officer prior to registration.

Coursework Requirements in Specialty Fields

Environmental Engineering

- 24 credits in CEE Department:
- 16 credits in specialty field with 12 of the 16 credits in core courses (core courses are indicated by an *).
  CE 5220, CE 6130*, CE 6150*, CE 6190*, CE 7100*, CE 7190*, CE 7200, CE 7220, CE 7260*
  Courses recommended for the remaining 8 credits are courses from part a or CE 5510, CE 5520, CE 5810, CE 6580, CE 7530, CE 7640

  1. Courses recommended for the remaining 8 credits to complete master's degree requirements are: ChE 5040, ChE 5530, ChE 6520, ChE 6590, 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.

  2. 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, CE7300*, CE 7350, CE 7370, CE 7410, CE 7460
2. Any deviations from the above requirements and the additional courses taken must be approved by the student's advisor and must be included in the student's Plan of Work.

**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 7600*, CE 7620*, CE 7630*, CE 7640*, CE 7670*
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, FBE 6090, FBE 6240, FBE 7010, FBE 7820, MGT 7060, MKT 7450, UP 6320, UP 6420, UP 6510, UP 6520, MAT 5070, MAT 5100, MAT 5220, MAT 5230, MAT 5710, MAT 5780, MAT 6830, EER 7630, EER 7650, EER 8650
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 5850, CE 6010*, CE6050*, CE 6060, CE 7020*, CE 7830*, CE 7850* CE7070
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.
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.

1. Plan of Work Form
2. Directed Study (CE 7900) and/or research (CE 7960) Forms (Request Form and Authorization Form)
3. Graduate Status Change / Transfer of Credit Form (if applicable)
4. Engineering Graduate Office Final Report Form (only for "Thesis" option, Plan A)

B. 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 division of these credits is as follows:

1. Twenty-eight credits of course work in the major (Civil and Environmental Engineering) beyond B.S.;
2. Eight credits in a minor outside the major department;
3. Thirty credits of dissertation direction;
4. Remaining credits may be coursework, directed study, or pre-dissertation research distributed over the major and minor areas.
5. Any deviations from the above must be approved by the student's advisor.

Minor: The Ph.D. program is designed to provide a strong concentration in the major field (Civil and Environmental Engineering) with supporting courses in a related field. At least one minor composed of eight or more credits must be elected outside the major department in a related field. Students can choose one minor or two minors. The minor (s) must be approved by the student's advisor.

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.
**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 Officer, 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.

**Advisor:** Upon 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, serving on 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 Qualifying Exam Committee and the Dissertation Committee.

The Qualifying Exam Committee must consist minimally of three members from the major department including the student's advisor. An extra-departmental member may be added at the discretion of the student's academic advisor. The Qualifying 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 and generally it is recommended that the extra-departmental member be from the student's minor area. 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 after the approval of the Graduate School require written justification. The Dissertation Committee administers the Qualifying Exam and Dissertation 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, geotechnical 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 Qualifying 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 Qualifying 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 Qualifying 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 Form which is approved by the members of the Qualifying Exam Committee and the Chair of the Department.

**Qualifying Exam**: The qualifying exam consists of a written and oral component, administered by the Dissertation Committee. The qualifying exam emphasizes the student's proposed dissertation research and also covers the student's major and minor fields. The written part of the exam consists of a research report prepared by the student. The student's advisor will ask the Graduate School of the arrangements for the oral part of the exam (using the Qualifying Examination Report Form) and submit names of the members of the Dissertation Committee for approval. 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 (9990) 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 ten credits of dissertation direction before admission to candidacy.

Prior to initiating research, the Ph.D. student must prepare in quadruplicate the Graduate School's Doctoral Dissertation Outline and Record of Approval Form. This form is approved by the student's Dissertation Committee and the departmental Graduate Program Officer. Following the departmental approval, all four copies are forwarded to the Graduate School for the Dean's approval and distribution.

**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 qualifying examinations and submits and receives the Graduate Dean's approval on the Dissertation Outline.

**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 and presided over by the Graduate School appointed Graduate Examiner, this final lecture shall be publicized to the entire academic community in advance by the student's research advisor and the departmental Graduate Program Officer. In the discussion following the presentation of a dissertation lecture,
other matters which the committee deems relevant may be introduced. The Dissertation Public Lecture Presentation is open to the general university community.

Two final signed copies of the dissertation 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 two copies.

**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.

**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 [http://phd.wayne.edu/forms.htm](http://phd.wayne.edu/forms.htm) for information on obtaining these forms.

1. Plan of Work Form
2. Directed Study (CE 7990) and/or research (CE 7996) Forms (Request Form and Authorization Form)
3. Graduate Status Change / Transfer of Credit Form (if applicable)
4. Preliminary Exam Form
5. Report on Qualifying Exams Form
6. Doctoral Dissertation: Outline and Record of Approval Form
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.
4. Graduate School: Advances student to Candidacy after approval of the research proposal.
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.
10. Department: Submits dissertation grade changes to the Graduate School.
CEE Graduate Course Descriptions

5220 Environmental Chemistry. Cr. 4

Prereq: C E 4210. Fundamentals of chemical principles and their application to unit operations and process encountered in the treatment of water and waste water. Material fee as indicated in the Schedule of Classes (B)

5230 Water Supply and Wastewater Engineering. Cr. 4

Prereq: C E 4210. Open only to students enrolled in professional Engineering programs. 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


5370 Finite Element Analysis Fundamentals. Cr. 4

Prereq: C E 4400 or M E 5600. Matrix structural analysis, discretization of continuous structural systems, stress analysis. Commercial finite element software preprocessing for developing finite element models; postprocessing for evaluating analysis results. (F)

5410 Hydrogen Infrastructure and Alternative Fuel Transportation. (AET 5410) Cr. 4

Prereq: senior standing in science or engineering discipline. Design, maintenance and operation of fuel-cell power generating facilities; handling of waste materials and waste disposal system design; design, construction, and operation of the infrastructure needed to transport hydrogen. (F)

5420 Alternative Energy Technologies for Various Transportation Modes. (AET 5420) Cr. 4

Prereq: senior standing in science or engineering discipline. Discussion of current alternative energy technology applications, emerging developments, national programs and priorities, future prospects, tax incentive programs, economics of scale issues, interrelationship between fixed costs and variable costs. (W)
**5510 Geotechnical Engineering I. Cr. 4**

Prereq: C E 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: C E 4510. Lateral earthpressure 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)

**5580 (HWM 5580) Land Disposal of Hazardous Waste. Cr. 2**

Prereq: HWM 5510. Industrial landfill, biological methods of disposal, land disposal techniques, ocean disposal techniques, disposal of flue gas cleaning wastes. (F)

**5590 (HWM 5590) Biological Methods of Waste Disposal. Cr. 2**

Prereq: HWM 5510. Biological treatment of industrial wastes, including unit operations, solids handling and activated carbon processes. (F)

**5610 Highway Design. Cr. 4**

Prereq: C E 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**

Open only to seniors and graduate students. 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: C E 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: C E 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: C E 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

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: C E 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: C E 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 Environmental Management and Sustainable Development. (HWM 6270) Cr. 4

Prereq: C E 4210. Review Introduction to engineering design and development within sustainability constraints: theoretical, regulatory and practical implications: Detroit and global applications (Y)

6330 Advanced Structural Analysis. Cr. 4

6340 Bridge Design and Evaluation. Cr. 4

Prereq: C E 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)

6525 (U P 6520) Transportation Policy and Planning. Cr. 3

Introduction to the role of transportation in the planning process involving both regional and urban considerations. (Y)

6580 Geoenvironmental Engineering I. Cr. 4

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

7020 Construction Safety. Cr. 4

Prereq: C E 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

Prereq: B E 3220, C E 4995, or equiv. 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)
7100 Water Resources Systems Analysis and Economics. Cr. 4

Prereq: C E 4210 or consent of instructor. Water resource and planning. Application of probability and operation research techniques for planning of water resources including engineering analysis, economic objective and water resource principles. (B)

7190 Groundwater Modeling. Cr. 4

Prereq: C E 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)

7200 Environmental Engineering Operations and Processes. Cr. 4

Prereq: C E 4210. Theoretical aspects and applications of various operations and processes of importance in pollution and control including sedimentation, flotation, coagulation, softening and filtration through granular media. Material fee as indicated in the Schedule of Classes (B)

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: C E 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)

7300 Advanced Structural Mechanics. Cr. 4

Prereq: C E 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)

7350 Structural Dynamics. Cr. 4

Prereq: C E 5350 or consent of instructor. Dynamic analysis of civil engineering structures, lumped-mass and distributed mass systems, linear and non-linear systems, approximate methods of analysis, computer applications, seismic design of buildings. (B)
7370 Advanced Finite Element Analysis. Cr. 4
Prereq: C E 5370. Advanced topics in finite element analysis; stability analysis and vibrations of structural systems. Modeling of complex structures, dynamic analysis, nonlinear structural problems. Computer applications. (W)

7410 Assessment and Upgrade of Structures. Cr. 4
Prereq: C E 6370, 6410. Methods of determining deficiencies of existing structures, experimental assessment/appraisal of structures, analytical computer assessment/appraisal of existing structures, upgrade methodology of existing structures. (Y)

7450 Nondestructive Testing for Structural Evaluation. Cr. 4
Prereq: C E 4350, 4450. Nondestructive testing methods applicable to appraisal of structures and materials; visual, optical, holographic imaging; magnetic flux, eddy current, acoustic, ultrasonic techniques. Laboratory applications. (Y)

7460 Advanced Composite Materials for Civil Infrastructure. Cr. 4
Prereq: C E 4450 or consent of instructor. 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: C E 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)

7510 Soil-Structure Interaction. Cr. 4
Prereq: C E 5510 or 5520. Applications of finite difference methods to short- and long-term settlement analyses, applications of finite element methods to static and dynamic analyses of soil-structure interaction systems, and applications of boundary element methods in geotechnical engineering. (B)

7520 Soil Dynamics. Cr. 4
Prereq: C E 4510 or consent of instructor. Fundamental theories and numerical techniques for vibration analysis and their application to solution of dynamic and earthquake problems in geotechnical engineering. (B)
**7530 Advanced Soil Mechanics. Cr. 4**

Prereq: C E 4510 or consent of instructor. 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. Material fee as indicated in the Schedule of Classes (B)

**7540 Soil Plasticity. Cr. 4**

Prereq: C E 5510, 5520, or consent of instructor. Theories of plasticity and rigid plasticity, theoretical backgrounds in state of the art elastoplastic stress-strain-strength models of soils for both static and cyclic loading conditions, numerical implementation of such models to boundary-value problems, and lower- and upper-bound solutions in geotechnical engineering. (Y)

**7550 Geosynthetics Engineering. Cr. 4**

Prereq: C E 4510. 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**

Prereq: C E 4640. 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**

Prereq: C E 4640. 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**

Prereq: C E 4600. 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. (I E 7640) Cr. 4

Prereq: C E 4850 or I E 5870. 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

Prereq: C E 7620. Analysis and design of traffic signal systems. Hardware, communication and detection systems associated with microcomputer-based signal systems. Coordinated signal systems. (B)

7685 Transit Research Seminar. Cr. 2

Prereq: graduate standing. Advanced topics including: planning, design, operation, maintenance, scheduling, marketing and institution aspects; presented by established researchers and professionals. (B)

7830 Construction Planning and Scheduling. Cr. 3

Prereq: C E 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: C E 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: C E 6010 : This course provides an overview of construction contract administration covers also how to utilize Microsoft Excel, Primavera Expedition, and prolog Manager software for construction administration and management.

7860 Construction Accounting and Financial Management. Cr. 3

Prereq: C E 6010 : Overview of the fundamental principles to successfully manage the finances of construction companies. These are attributed to business management, engineering economics, accounting, cost estimating and project management.

7890 Integrated Construction Project Management. Cr. 3

Prereq: C E 6010 : This course provides a comprehensive overview construction project management knowledge areas. It describes the processes required to ensure that the various elements of the project are properly coordinated. It explains how o use different project management software for integrated construction project 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; C E 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; C E 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; C E 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 C E 9999, or 9991-9994. Offered for S and U grades only. (T)