THE UNIVERSITY OF TOLEDO
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College of Engineering

Department of Civil and Environmental Engineering

Graduate Student Handbook
2016-2018

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Apul, Defne	defne.apul@utoledo.edu	**8132**	**3030**	**Environmental**
Chou, Yein Juin (Eddie)	eddie.chou@utoledo.edu	**8123**	**3022**	**Transportation**
Gruden, Cyndee	cyndee.gruden@utoledo.edu	**8128**	**3024**	**Environmental**
Hu, Liangbo	liangbo.hu@utoledo.edu	**8124**	**3023**	**Geotechnical**
Guner, Serhan	serhan.guner@utoledo.edu	**8133**	**3021**	**Structural**
Kumar, Ashok	ashok.kumar@utoledo.edu	**8136**	**3036**	**Environmental**
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Seo, Youngwoo	youngwoo.seo@utoledo.edu	**8131**	**3031**	**Environmental**
Kang, Dae Wook	dae-wook.kang@utoledo.edu	**TBD**	**3025**	**Environmental**

Academic & Research Programs

I A. Infrastructure Engineering: Structural & Earthquake Engineering
Focus Sub-Group Leader - Dr. Nims
Faculty: Drs. Nims, Parvin, Guner

Research Areas

Structural Analysis, Finite Element and Boundary Element Methods, Optimal Systems Design, Structural Optimization, Structural Stability, Structural Dynamics, Earthquake Engineering, Computer-Aided Structural Analysis and Design, Fluid Propulsion, Experimental Mechanics, Concrete Shear Response Modeling, Concrete Beam-Column Connections, Spring and Elastomeric Bridge Bearings, Seismic Load Analysis, Impact and Blast Loading on Structural Elements Analysis, Design and Behavior of Reinforced Concrete Structures, Design and Behavior of Steel Structures, Design and Behavior of Masonry Structures, Retrofit and Rehabilitation of Reinforced Concrete Structures by Use of Fiber Composites, Earthquake Engineering of Bridges and Buildings, Nonlinear Finite Element Analysis and Laboratory Testing of Structural Components, Bridge design and analysis.

I B. Infrastructure Engineering: Transportation & Geotechnical Engineering
Focus Sub-Group Leader - Dr. Chou
Faculty: Drs. Chou, Randolph, Hu

Research Areas – Transportation

Transportation Facilities Design, Systems Analysis, Traffic Signals Design, Engineering Material Characterization, Pavement Performance Evaluation, Infrastructure Management, Urban Transportation Planning and Systems Design, Intelligent Transportation Systems, Traffic Flow Modeling, Transportation Infrastructure Systems Transportation Infrastructure Systems Design

Research Areas – Geotechnical

Mathematical Modeling, Analysis of Deep Foundations, Testing and Modeling of Unsaturated Soils, In Situ Instrumentation and Testing, Laboratory Soil Testing and Equipment Development, Subsurface Flow Modeling, Geologic System Reliability, Geosynthetics, Non-intrusive Soil Testing, Ground Water Hydrology, Heavy Metal Contamination Characterization and Site Evaluation, Geosensing, Remote Sensing Using Field Portable X-ray Fluorescence and Infra-red Spectroscopy, Use of Global Positioning Systems and Geographical Information Systems

II Environmental and Geo-environmental Engineering
Focus Group Leader - Dr. Kumar
Faculty: Drs. Kumar, Gruden, Apul, Seo

Research Areas – Environmental and Geo-environmental

Indoor and Outdoor Air Quality, Sustainable Buildings, Beneficial Reuse of Waste Material, Contaminated Sediments, Microbial Degradation of Organic Compounds, Microbial Sensors, Computer Modeling of Contaminant Release and Dispersion in Soils and in Air, Environmental Decision Making, Unsaturated Soils, Air Quality Models for Industries, Acid Rain and Risk Assessment, Modeling of Hazardous Releases, Environmental Modeling and Environmental Sensing, Air Pollution Modeling, Wastewater Treatment Processes, Water Quality Control, Water Treatment Processes.

Basic Requirements

A minimum of 30 semester credits is required for the Master of Science in Civil Engineering (MSCE) degree: 21 credits of approved graduate course work (a minimum of 9 credit hours should be 6000 level or above) and 9 credits for thesis research performed under the supervision of a full-time faculty member of the Department of Civil and Environmental Engineering who holds membership in the Graduate Faculty of the University. The Department of Civil and Environmental Engineering also offers a MSCE degree with a project option. In the project option, a minimum of 30 semester credits is required: 24 credits for approved graduate course work (a minimum of 12 credit hours should be 6000 level or above) and six credits for the project report.

Plan of Study and Courses

All students who are on Tuitions Scholarship or plan to be a Teaching Assistant or Research Assistant are required to meet with faculty in their respective area of study during the first semester and prior to the Spring Semester of the first year to discuss research opportunities and interest. It is the responsibility of the student to schedule these appointments. Students must complete the "Faculty Research Interview Form" (see Appendix II) and submit it with the plan of study to the Assistant Director, Department Student Services.

A. Each student must prepare a Plan of Study in conjunction with his/her faculty adviser (Focus Area Leader or the Graduate Director until a faculty adviser has been found) with a concentration of required and elective courses in one of the Department's programs of graduate study before the Spring Semester of his or her first year. The Plan of Study must be signed by the faculty adviser before submission for approval by the Graduate Program Director, the Assistant Dean for Graduate Studies and Research and the Graduate School. Required core courses in each area are determined by the faculty comprising that graduate program group in conjunction with the Graduate Program Director. Current program core courses are listed in Section 6.7. See Appendix I for complete instruction on completing the plan of study.
B. Courses taken on an audit basis do not count toward the degree.
C. A maximum of six credits of Independent Study is allowed toward the degree.
D. While appropriate graduate credits may be transferred, no more than nine credits earned at another university may be used toward the MSCE, and in no case may the thesis or project be satisfied by work done elsewhere.

Time Limit

The MSCE degree may be pursued on a full-time or part-time basis. However, each student must complete all requirements for the MSCE degree no later than six years from the date of first registration. It is strongly suggested that full-time students finish the MSCE Graduate Program within one and one-half years and part-time students complete the program within a three-year period.

Formation of Thesis Advisory Committee

A thesis advisory committee is selected by the faculty adviser in consultation with the student. The names of the committee members are submitted to the Graduate Program Director on the Notice of Thesis form, to be forwarded to the Graduate School for final approval. An Assurance of Compliance form should be completed by the student and faculty adviser and accompany the Notice of Thesis. The thesis advisory committee is composed of a minimum of three full-time faculty

members with professorial rank, at least one of whom is a full member of the University Graduate Faculty. If the faculty adviser holds full membership in the Graduate Faculty, they will serve as chairperson of the committee. If this is not true, the Graduate Program Director will appoint a member of the thesis advisory committee with full membership in the Graduate Faculty to serve as chairperson. At least two members of the MSCE thesis committee must be tenure-track, full-time, teaching faculty members of the Department of Civil and Environmental Engineering with professorial rank.

The major responsibility of the thesis committee is to evaluate the MSCE thesis proposal written by the student and to approve or disapprove the final defense of the MSCE thesis. Other responsibilities include assisting in developing the student's Plan of Study and assisting in the advising of thesis work, if requested by the thesis adviser and the student.

Thesis Submission, Defense and Acceptance

It is the student's responsibility to complete all necessary steps to meet the published deadlines for the term in which they plan to graduate. Guidelines are available on the web page at: http://www.eng.utoledo.edu/civil/graduate/Guidelines.pdf . A MSCE thesis should be prepared by the student when the research is completed to the satisfaction of the faculty adviser. Students may obtain directions for thesis preparation from the Assistant Director, Department Student Services or the Graduate School web page. The faculty adviser may recommend that the student examine copies of recent theses prepared for the MSCE and housed in the Department office and Carlson Library. The draft thesis should be submitted to the faculty adviser with adequate time for critical review and evaluation. After the faculty adviser has reviewed the thesis, supervised recommended changes and approved the final text and form of the document, the student should prepare and submit thesis copies to his/her thesis advisory committee for evaluation. A copy of the thesis should be in the hands of each member of the committee at least two weeks before the scheduled final defense so that the committee members have ample time for a careful review.

A final defense of the thesis is required. The student, in consultation with his/her faculty adviser, will schedule the thesis defense at a time when the thesis advisory committee can meet. All members of the thesis advisory committee should be present at the final defense. The faculty adviser will instruct the student regarding specific materials which must be presented at the defense. The thesis is presented and defended in an open meeting presided over by the thesis advisory committee chairperson. It must be publicized on a standard form obtained from the Assistant Director, Department Student Services and posted in prominent places around the Department at least one week before the defense date.

The student is allowed approximately 30-45 minutes for the oral presentation of the thesis, at the discretion of the committee chairperson. The presentation is an important reflection of the student's best technical work and should be well prepared. Visual aids are recommended when appropriate for the clear presentation of the thesis. Following the oral presentation, the thesis advisory committee, other faculty, students, and guests are invited to ask questions. After the question and discussion period is concluded, the audience is excused by the committee chair. The thesis advisory committee then continues the examination.

The thesis advisory committee will vote forthwith whether the student's thesis is acceptable and has been successfully defended. A majority of the committee must concur on the final decision. If the decision is negative, then the thesis advisory committee will decide upon a future course of action in

consultation with the Graduate Program Director. If the decision is positive, the thesis advisory committee may still require changes or additions/deletions in the thesis as a result of their evaluation. These changes must be made by the student and approved by the faculty adviser. The required number of final corrected copies must be submitted to the adviser, Department and Graduate School by the published due date established for the desired term of graduation.

The thesis must be prepared and submitted in accordance with Graduate School regulations. Your advisor may require a bound copy. The Civil and Environmental Engineering Department requires an electronic copy to be submitted to the Graduate Program Director in an acceptable format. You must meet all the requirements of the Graduate School for archival storage in the university library and OhioLink as described on their web page. At his/her discretion, the student may prepare and bind additional copies for thesis advisory committee members.

The student must schedule a final check-out appointment with the Assistant Director, Department Student Services before the Department can certify the student for graduation. At this time a check will be performed to assure compliance with all degree requirements and to identify any administrative matters that may delay graduation. Students are advised to schedule a preliminary check-out at least one term prior to the expected graduation to aid in a smooth completion of all requirements.

Part Time Graduate Studies

The Department's graduate faculty has approved a program of study for the Master of Science degree that allows the student to pursue the degree on a part-time basis. Since the Department offers only a limited number of graduate courses in the evening, the student must make arrangements with his/her employer prior to admission, to permit enrollment in Department courses scheduled during the day in order to pursue his/her program of study.

Structured Graduate Program for each Research Area in Civil and Engineering Update 2014

- **Environmental and Geo-environmental Program** (Drs. Apul, Gruden, Kumar, Randolph, Seo, Hu)

  Thesis Option**: 21 credit hours of course work and 9 credit hours of thesis.**

  Project Option**: 24-27 credits hours of course work and 3-6 credit hours of project.**

  Course Work Option: **30 hours of course work. Selection of all courses requires approval from your graduate advisor.**

  A. Environmental Core (9 credit hours minimum)
  1. CIVE 6670 Lifecycle Engineering - 3 credit hrs
  2. CIVE 6630 Dispersion Modeling - 3 credit hrs
  3. CIVE 6900 Environmental Geotechnology - 3 credit hrs
  4. CIVE 6900 Advanced Biological Processes - 3 credit hrs

  Alternatives are possible pending advisor approval.

  B. Analysis Core (3 credit hours minimum)
  Suggested Courses
  1. MIME 6000 Advanced Engineering Mathematics I - 3 credit hrs
  2. CIVE 5710 Advanced Engineering System Modeling - 3 credit hrs
  3. MATH courses as approved by advisor

  Alternatives are possible pending advisor approval.

  C. Graduate Research
  1. CIVE 6960 Masters Thesis - 9 credit hours.
  2. CIVE 6980 Masters Project - 6 credit hours.

  D. Environmental Engineering Related Electives (6 credit hour minimum for thesis option and 9 credit hour minimum for project option)

  All electives are subject to approval from your graduate advisor.

See Table 2 for Course Listings.
Selections Require Advisor Approval.

- **Infrastructure Area** (Effective from Spring 2014)

(Drs. Chou, Guner, Hu, Nims, Parvin, Randolph)

Thesis Option: **21 credit hours of course work and 9 credit hours of thesis.**
Project Option: **24 credits hours of course work and 6 credit hours of project.**
Course Work Option: **30 hours of course work. Selection of all courses requires approval from your graduate advisor.**

Proposed Core Courses

E. Infrastructure Core (9 credit hours minimum from the following five areas)

1. Infrastructure Systems Management (3 credit hours) or Environmental Geotechnology (3 credit hours)
2. Mechanics of Stability (3 credit hours) or Dynamics of Structures (3 credit hours) or Advanced Mechanics of Materials (3 credit hours) or Traffic Control (3 credit hours) or Nonlinear Modeling of Reinforced Concrete (3 credit hours)
3. Advanced Foundation Engineering (3 credit hours) or Advanced Soil Mechanics (3 credit hours) or Advanced Geotechnical Engineering (3 Credit hours)
4. Advanced Composite Materials in Infrastructure (3 credit hours)
5. A second design graduate level course approved by the advisor.

F. Analysis Core (3 credit hours minimum)

1. Finite Element Methods - 3 credit hours (required for all those specialize in Structures),
2. Advanced Engineering System Modeling – 3 credit hours, or
3. Mathematics (MATH) course: Need advisor approval - 3 credit hours

G. Graduate Research

1. CIVE 6960 Masters Thesis - 9 credit hours.
2. CIVE 6980 Masters Project - 6 credit hours.

H. Infrastructure Engineering Related Electives (6 credit hour minimum for thesis option and 9 credit hour minimum for project option)

All electives are subject to approval from your graduate advisor.

See Table 2 for Course Listings.
Selections Require Advisor Approval.

Table 1: Suggested Analysis Course Listing				
S.N.	**Code**	**Number**	**Course Name**	**Cr.Hrs**
1	**CIVE**	**5710**	Advanced Engineering Systems Modeling	**3**
2	**MATH**	**5620**	Linear Statistical Models	**3**
3	**MATH**	**5630**	Theory and Methods of Sample Surveys	**3**
4	**MATH**	**5640**	Statistical Computing	**3**
5	**MATH**	**5660**	Applied Probability	**3**
6	**MATH**	**5670**	Design of Experiments	**3**
7	**MATH**	**5680**	Intro. to Theory of Probability	**3**
8	**MATH**	**5690**	Introduction to Mathematical Statistics	**3**
9	**MATH**	**5710**	Methods of Numerical Analysis I	**3**
10	**MATH**	**5720**	Methods of Numerical Analysis II	**3**
11	**MATH**	**5740**	Advanced Applied Mathematics I	**3**
12	**MATH**	**5750**	Advanced Applied Mathematics II	**3**
13	**MATH**	**5780**	Advanced Calculus	**3**
14	**MATH**	**5790**	Advanced Optimization	**3**
15	**MATH**	**5800**	Ordinary Differential Equations	**3**
16	**MATH**	**5810**	Partial Differential Equations	**3**
17	**MATH**	**5860**	Calculus of Variations and Optimal Control Theory I	**3**
18	**MATH**	**5870**	Calculus of Variations and Optimal Control Theory II	**3**
19	**MATH**	**6180**	Linear and Nonlinear Programming	**3**
20	**MATH**	**6190**	Infinite Dimensional Optimization	**3**
21	**MATH**	**6500**	Ordinary Differential Equations	**3**
22	**MATH**	**6510**	Partial Differential Equations	**3**
23	**MATH**	**6600**	Statistical Consulting I	**3**
24	**MATH**	**6640**	Topics in Statistics	**3**
25	**MATH**	**6650**	Statistical Inference	**3**
26	**MATH**	**6670**	Measure-Theoretic Probability	**3**
27	**MATH**	**6680**	Theory of Statistics	**3**
28	**MATH**	**6690**	Multivariate Statistics	**3**
29	**MIME**	**5600**	Engineering Statistics I	**3**
30	**MIME**	**5610**	Engineering Statistics II	**3**
31	**MIME**	**5640**	Random Processes	**3**
32	**MIME**	**5690**	Reliability	**3**
33	**MIME**	**5730**	Forecasting	**3**
34	**MIME**	**5780**	Advanced Engineering Economy and Decision Theo.	**3**
35	**MIME**	**6000**	Advanced Engineering Mathematics I	**3**
36	**MIME**	**6100**	Advanced Engineering Mathematics II	**3**
37	**MIME**	**6150**	Applied Numerical Methods I	**3**
38	**MIME**	**6170**	Applied Numerical Methods II	**3**
39	**MIME**	**6620**	Engineering Application of Statistical Analysis	**3**
40	**MIME**	**6630**	Applied Statistical Methods	**3**
41	**MIME**	**6670**	Queuing Theory	**3**
42	**MIME**	**6740**	Optimization Theory and Applications	**3**

43	**MIME**	**6700**	Linear Statistical Methods	**3**
44	**MIME**	**6760**	Applied Math Programming	**3**

Table 2: Environmental Area Course Listing

S.N.	Code	Number	Course Name	Cr.Hrs
1	**CHEE**	**5160**	Industrial Waste Treatment	**3**
2	**CHEE**	**5180**	Hazardous Material Spills	**3**
3	**CHEE**	**6550**	Transport Phenomena I	**3**
4	**CHEE**	**6560**	Transport Phenomena II	**3**
5	**CHEM**	**6300**	Advanced Analytical Chemistry	**2 to 4**
6	**CHEM**	**6310**	Separation Methods	**2 to 4**
7	**CHEM**	**6320**	Characterization of Condensed Phases and Surfaces	**2 to 4**
8	**CHEM**	**6330**	Spectroscopic Methods and Analysis of Spectra	**2 to 4**
9	**CIVE**	**5610**	Hydrology and Water Resources Engineering	**3**
10	**CIVE**	**5620**	Open Channel Flow Hydraulics	**3**
11	**CIVE**	**5630**	Indoor Air Quality	**3**
12	**CIVE**	**5630**	Industrial Hygiene	**3**
13	**CIVE**	**5650**	Industrial Ventilation	**3**
14	**CIVE**	**5670**	Solid Waste Management and Disposal	**3**
15	**CIVE**	**5680**	Environmental Law	**3**
16	**CIVE**	**6610**	Physical, Chemical, and Biological Processes	**3**
17	**CIVE**	**6620**	Environmental Modeling	**3**
18	**CIVE**	**6630**	Dispersion and Risk Modeling	**3**
19	**CIVE**	**6640**	Environmental Engineering Chemistry	**3**
20	**CIVE**	**6650**	Environmental Engineering Microbiology	**3**
21	**CIVE**	**6660**	Advanced Treatment Processes	**3**
22	**CIVE**	**6680**	Sediment Transport	**3**
23	**CIVE**	**6690**	Dispersion Modeling Laboratory	**3**

Table 3: Geotechnical and Geo-environmental Area Course Listing

S.N.	Code	Number	Course Name	Cr.Hrs
1	**CIVE**	**5210**	Advanced Soil Mechanics	**3**
2	**CIVE**	**5220**	Advanced Foundation Engineering	**3**
3	**CIVE**	**5240**	Design with Geo-synthetics	**3**
4	**CIVE**	**5260**	Experimental Soil Mechanics	**3**
5	**CIVE**	**6230**	Ground Water Modeling	**3**
6	**CIVE**	**6250**	Mechanics of Unsaturated Soil	**3**
7	**CIVE**	**6260**	Numerical Analysis for Geo-mechanics	**3**
8	**CIVE**	**6270**	Contaminant Transport Modeling	**3**
9	**EEES**	**5220**	Environmental Geochemistry	**3**
10	**EEES**	**5410**	Hydrogeology	**3**
11	**EEES**	**5450**	Hazardous Waste Management	**3**
12	**EEES**	**6440**	Contaminant Hydro-geology	**3**
13	**EEES**	**6450**	Advanced Applied Hydrogeology	**3**
14	**CIVE**	**6320**	Advanced Finite Element Methods	**3**

15	**CIVE**	**5900-001**	Advanced Landfill Design	**3**
16	**CIVE**	**6900-001**	Advanced Geotechnical Engineering	**3**
17	**CIVE**	**6900-154**	Environmental Geotechnology	**3**
18	**CIVE**	**6670-126**	Life Cycle Engineering	**3**
19	**MIME**	**6200**	Advanced Dynamics	**3**
20	**MIME**	**6300**	Continuum Mechanics	**3**
21	**MIME**	**6350**	Elasticity	**3**
22	**MIME**	**6360**	Plasticity	**3**
23	**MIME**	**6430**	Advanced Thermodynamics	**3**
24	**MIME**	**6440**	Computational Fluid Dynamics I	**3**

Table 4: Structural Area Course Listing

S.N.	Code	Number	Course Name	Cr.Hrs
1	**CIVE**	**5300**	Advanced Mechanics of Materials	**3**
2	**CIVE**	**5340**	Experimental Mechanics	**3**
3	**CIVE**	**5430**	Structural Steel Design II	**3**
4	**CIVE**	**5440**	Reinforced Concrete Design II	**3**
5	**CIVE**	**5450**	Bridge Design I	**3**
6	**CIVE**	**5480**	Reinforced Masonry Design	**3**
7	**CIVE**	**6460**	Advanced Composite Materials in Infrastructure	**3**
8	**CIVE**	**6310**	Finite Element Methods	**3**
9	**CIVE**	**6320**	Advanced Finite Element Methods	**3**
10	**CIVE**	**6330**	Optimum Structural Design	**3**
11	**CIVE**	**6340**	Mechanics of Stability	**3**
12	**CIVE**	**6360**	Dynamics of Structures	**3**
13	**CIVE**	**6390**	Wind Load Analysis and Design	**3**
14	**CIVE**	**6430**	Behavior of Steel Structures	**3**
15	**CIVE**	**6440**	Behavior of Reinforced Concrete Structures	**3**
16	**CIVE**	**6450**	Seismic-Resistant Design	**3**
17	**CIVE**	**6470**	Plastic Analysis of Structures	**3**
18	**CIVE**	**6480**	Pre-stressed Concrete Structures	**3**
19	**CIVE**	**6490**	Nonlinear Modeling of Reinforced Concrete	**3**
20	**MIME**	**5280**	CAD - Finite Element Methods	**3**
21	**MIME**	**5300**	Advanced Mechanics of Materials	**3**
22	**MIME**	**5310**	Mechanics of Composite Materials	**3**
23	**MIME**	**5320**	Fatigue of Materials and Structures	**3**
24	**MIME**	**5340**	Experimental Mechanics	**3**
25	**MIME**	**6150**	Applied Numerical methods I	**3**
26	**MIME**	**6200**	Advanced Dynamics	**3**
27	**MIME**	**6210**	Advanced Mechanical Vibrations	**3**
28	**MIME**	**6300**	Continuum Mechanics	**3**
29	**MIME**	**6320**	Advanced Finite Elements	**3**
31	**MIME**	**6350**	Elasticity	**3**
32	**MIME**	**6360**	Plasticity	**3**
33	**MIME**	**6380**	Fracture Mechanics	**3**

Table 5: Transportation Area Course Listing				
S.N.	**Code**	**Number**	**Course Name**	**Cr.Hrs**
1	**CIVE**	**5240**	Design with Geosynthetics	**3**
2	**CIVE**	**5450**	Bridge Design I	**3**
3	**CIVE**	**5510**	Materials Engineering	**3**
4	**CIVE**	**5550**	Traffic Control	**3**
5	**CIVE**	**5710**	Advance Engineering System Modeling	**3**
6	**CIVE**	**6510**	Pavement Design and Analysis	**3**
7	**CIVE**	**6520**	Infrastructure Systems Management	**3**
8	**CIVE**	**6550**	Urban Transportation Design	**3**
9	**CIVE**	**6560**	Transportation System Management and Economics	**3**
10	**CIVE**	**6570**	Traffic Flow Theory and Simulation Models	**3**
11	**CIVE**	**6580**	Intelligent Transportation Systems	**3**
12	**CIVE**	**6590**	Traffic Signal Design and Operations	**3**
13	**CIVE**	**6840**	Applied GIS for Civil Engineering	**3**
14	**CIVE**	**6900**	Civil Engineering Problems	**1 to 6**
15	**CIVE**	**7900**	Independent Problems	**1 to 6**
16	**CIVE**	**8900**	Independent Problems	**1 to 6**
17	**EECS**	**5220**	Programmable Logic Controllers	**3**
18	**EECS**	**5320**	Industrial Imaging Systems	**3**
19	**EECS**	**5330**	Image Analysis and Computer Vision	**3**
20	**EECS**	**5340**	Imaging Architectures and Hardware	**3**
21	**EECS**	**5360**	Communication Systems	**3**
22	**EECS**	**5370**	Information Theory and Coding	**3**
23	**EECS**	**5580**	Survey of Artificial Intelligence	**4**
24	**EECS**	**5560**	Database Systems I	**3**
25	**EECS**	**5570**	Database Systems II	**3**
26	**GEPL**	**5510**	Introduction to GIS	**4**
27	**GEPL**	**5600**	Urban Design	**3**
29	**GEPL**	**6190**	Advanced Geographic Info Systems Seminar	**4**
30	**MIME**	**5780**	Advanced Engineering Economy and Decision Theory	**3**
31	**MIME**	**6780**	Advanced Engineering Management	**3**

REQUIREMENTS FOR DOCTOR OF PHILOSOPHY (Ph.D.) DEGREE

Basic Requirements

The Doctor of Philosophy Degree is conferred on the basis of extended study and high scholarly attainment in a field of learning. For the Ph.D. degree, a minimum of 90 graduate semester credits are required, of which 45 credits are for graduate course work (largely departmental) and 45 credits for dissertation research under the supervision of a full-time faculty member of the Department of Civil and Environmental Engineering. The graduate course work must include a minimum of 9 credits of approved engineering analysis courses (see Section 6). Students admitted to the Ph.D. program with an appropriate M.S. degree are granted up to 30 course work credits for the M.S. degree that can be applied toward the Ph.D. degree requirements. A minimum of 45 credits beyond M.S. requirements must be completed at The University of Toledo, with no more than 3 credits of independent studies.

In order to be awarded the degree of Doctor of Philosophy, the student must have at least a B average (GPA of 3.0) for all the credits in his/her program of study and a GPA of at least 3.0 for all the credits offered by the Department of Civil and Environmental Engineering. Please see Section 9 for further details on grade requirements for graduation.

In addition, the student must be admitted into doctoral candidacy and pursue an original research problem. Admission to the doctoral program does not constitute admission to candidacy. See Section 7.5 for requirements for admission to doctoral candidacy. The research must be completed and the dissertation written and successfully defended in public before the Ph.D. degree is conferred. The doctoral program is normally a full-time program throughout all of the course work and the dissertation. The Department of Civil and Environmental Engineering does not encourage part-time studies in the Ph.D. program.

Direct Route to the Ph.D.

Outstanding students entering the Graduate Program with a bachelor's degree (in accordance with the admission requirements of Section 2) and wishing to proceed directly into the doctoral program without obtaining the MSCE degree may be permitted to do so. These individuals must satisfy the following two requirements.

1. Successful completion of the normal 21 semester credits of course work required for the ‘MSCE degree with theses as described in Section 6.2. The student is not required to complete the MSCE thesis.
2. Satisfactory performance on the Ph.D. Qualifying Examination as described in Section 7.6.

On successfully completing these requirements, the student is then allowed to proceed with the remaining doctoral program requirements as discussed in Sections 7.1 and 7.3-7.9. Students pursuing the direct route program who subsequently decide to terminate their program, or are advised to terminate by their advisory committee prior to completing the Ph.D., may be awarded the MSCE if they satisfy the MSCE degree requirements of Section 6.

Program of Study

Doctoral students, in consultation with the Graduate Program Director, Department Chair and focus area faculty, should select a faculty adviser during their first term of study, as outlined in Section 5. Since the adviser is expected to become the student's dissertation supervisor, selection should be based on mutual agreement and common interests. It is the responsibility of both the student and his/her faculty adviser to formulate a program of study to meet the objectives and needs of the student. Sections 2, 3 and 6 of the Doctoral Program Proposal form (Appendix F) should be completed by the student and approved by the faculty adviser and the Graduate Program Director within the first term of the doctoral program. The student's program of study should contain both breadth of knowledge and depth of specialization. The final authority for a student's program of study is vested in the student's faculty adviser and the Graduate Program Director, subject to the final approval of the Graduate School. Revisions of a student's program of study are to be expected but must be approved by the faculty adviser and the Graduate Program Director, before submission to the Graduate School for final approval.

If a student does not have adequate preparation in civil engineering, the faculty adviser may require prerequisites for graduate course work that may include undergraduate course work. This prerequisite course work is in addition to the minimum graduate credits required for the Ph.D. degree.

Full-time students must be registered for a minimum of 15 graduate credits each semester, excluding the Summer Semester. Courses taken on an audit basis are excluded from these numbers and do not count towards the degree.

Formation of the Advisory Committee

Early in the second semester of the program the student and his/her faculty adviser should agree upon a general area for the dissertation. An advisory committee is selected by the faculty adviser and the student and submitted to the Graduate Program Director and Department Chair for approval by completing Section 5 of the Doctoral Program Proposal form (Appendix F).

The advisory committee is composed of at least five full-time members of the Graduate Faculty, of which one must be from outside the focus area and one from outside the Department. The faculty adviser will be the chairperson of the committee. If the faculty adviser is not a full member of the Graduate Faculty, another member of the advisory committee who is a full member of the Graduate faculty will be appointed by the Graduate Program Director as committee chairperson. At least three members of the advisory committee must be tenure track, full-time, teaching faculty members of the Department of Civil and Environmental Engineering with professorial rank and Graduate Faculty membership. These three members of the committee cannot include the rank of instructor or be adjunct, research or joint appointment faculty with a majority appointment in a department other than Civil and Environmental Engineering. However, the Graduate Program Director of the Department could waive the requirement of three members from the Department of Civil and Environmental Engineering to the College of Engineering at the request of the dissertation advisor depending on the area of concentration. The Graduate Program Director could approve the request for environmental area without involving Graduate Program Committee. For infrastructure area, the Graduate Program Director after approval of the Graduate

the Department of Civil and Environmental Engineering to the College of Engineering at the request of the dissertation advisor. A documentation of the decision will be added to the student file.

The responsibilities of the committee include the following:

A. Assist the student in modifying his/her program of study, if requested by the student's faculty adviser.

B. Submit questions for the written qualifying examination. Evaluate the student's dissertation research proposal, its presentation and defense.

C. Advise and assist the student in dissertation research if requested by the student and/or his/her Faculty Adviser.

D. Evaluate the Ph.D. dissertation written by the student and approve or disapprove the final defense of the dissertation.

Admission to Doctoral Candidacy

All doctoral students must meet the following requirements for admission to doctoral candidacy.

A. Successful completion of all doctoral course work on the Doctoral Program Proposal with a grade point average of at least 3.00.

B. Satisfactory performance on the Doctoral Qualifying Examination as determined by the Department's faculty.

C. Selection of a faculty adviser and successful formation of an advisory committee.

D. Successful completion of the dissertation proposal and passing of the oral defense and examination.

E. Completion of any special requirements of the advisory committee noted on the Doctoral Program Proposal.

F. Completion of an Application for Admission to Candidacy form approved by the faculty adviser and submitted to the Graduate Program Director for forwarding to the Graduate School.

Acceptance into candidacy will be formally indicated and the student will be so notified by letter from the Graduate Program Director after approval by the Dean of the Graduate School.

Doctoral Qualifying Examination

The doctoral qualifying examination is intended to test the breadth and depth of a student's

understanding of fundamentals and the most important and basic elements of the broad area of graduate studies in which the student is specializing. It is used to assess whether the student has the potential to carry his/her Ph.D. program to conclusion. The qualifying exam is a two-step process as described below:

1. The first step consists of a written examination. It is administered in the week prior to the midterm break of the Spring Semester. The written examination will be two four-hour segments, one closed book format and one open book format. Questions will be grouped in five subjects to test a requisite fundamental background in each focus area (environmental, geotechnical, structures and transportation) and mathematics. Each student must answer questions in two focus area subjects and in mathematics, which is mandatory for all examinees. A passing score is required in all three subjects. Students must take this examination prior to completing 60 graduate credits. This normally occurs in the first Spring Semester of doctoral study if a student has previously earned a master's degree.

2. The second step of the examination consists of an oral defense of the proposed dissertation research before the advisory committee. Prior to the defense, the student submits a written proposal to the committee. The defense consists of a brief presentation of the written proposal followed by a question and answer session. During the defense, the committee will assess the appropriateness of the proposed research for a doctoral dissertation and the student's ability to successfully complete the research. Students must successfully complete the proposal defense in the Fall Semester following the successful completion of the first step of the exam.

Time Line and Format for Doctoral Qualifying Examination

The following format and timeline are outlined for doctoral students in the Department of Civil and Environmental Engineering:

Step 1: All doctoral students should complete, in conjunction with their faculty adviser, Sections 2, 3 and 6 of a graduate school Doctoral Program Proposal (DPP) by the end of their first semester. The DPP should be approved by the student's faculty advisor and the Graduate Program Director (GPD).

Step 2: Each year in the 2nd week of Spring Semester, the Graduate Program Director (GPD) will notify all graduate students regarding the comprehensive examination procedure and dates of the preliminary examination. All graduate students who wish or need to take the examination should submit a written request to the GPD and identify the two focus area subjects upon which they will be examined. Mathematics is the third subject for all examinees.

Step 3: The GPD, with the aid of the Department Graduate Committee, will solicit questions for the written examination from graduate faculty representing the students' major area(s).

Step 4: The GPD and the Department Graduate Committee will prepare the written examination from the questions submitted. The written examination will be administered by the GPD on Thursday of the week prior to the midterm break of the Spring Semester. Upon completion of the written examination by the student, the GPD will send each problem back to the contributor for

grading on the basis of 0 to 100, with a passing grade of 70.

Step 5: The GPD will hold a meeting at least two weeks prior to the final examination week of the Spring Semester with the graduate faculty of the Department. At this meeting, the graded examinations and tabulated results for all problems will be reviewed by all attendees. All attendees will vote to pass or fail a student in each subject, based upon the student's performance on the written examination. A majority passing vote in three subject areas, including mathematics, is required to move to the second step of the qualifying examination.

Step 6: If a student fails any subject in the written examination, then he/she is allowed to be reexamined on those subjects once in the Spring Semester of the next academic year. If the student fails to pass the examination on the second attempt they will be dismissed from the doctoral program. In cases of failure, the student may consider the possibility of completing a MSCE degree.

Step 7: All doctoral students successful in the written examination will submit a written dissertation proposal to the advisory committee for review prior to an oral defense. During the defense, the committee will assess the appropriateness of the proposed research for a doctoral dissertation and the student's ability to successfully complete it. Students must defend their dissertation proposal by the end of the Fall semester following their successful passage of the written examination. Upon passing the written examination and dissertation proposal defense, the student has successfully completed the qualifying examination.

Dissertation Proposal Defense and Examination

The student must prepare, in consultation with his/her faculty adviser, a detailed and well-written proposal of the doctoral dissertation research to be undertaken. The written proposal must be prepared to the satisfaction of the faculty adviser in advance of the presentation. After the faculty advisor's approval, copies of the written proposal must be given to all members of the advisory committee at least one week before the oral presentation. The dissertation proposal must then be presented in an oral presentation before the advisory committee and defended to the committee's satisfaction. In general, the proposal defense will be restricted to material pertaining to the dissertation proposal and its presentation.

Dissertation proposal writing and presentation can be a valuable learning experience in which the student has an opportunity to develop the ability to search the literature, evaluate and plan dissertation research, and to orally present and defend proposed research and ideas to the dissertation committee. This is also an excellent way to establish communication between the student, the faculty adviser, and the advisory committee.

The dissertation proposal presentation and defense is to be in an announced meeting open to the advisory committee, as well as departmental and other invited faculty, with arrangements made by the chairperson of the advisory committee. The majority decision of the advisory committee will determine whether the student has passed the proposal defense, though other departmental faculty may be present and contribute to the deliberations. At this point, provided the student has passed his/her preliminary exam, completed all the course work on the DPP and completed any special requirements noted on the DPP by the advisory committee, the student may apply for admission to

candidacy by completing an Application for Admission to Candidacy form to be approved by the faculty adviser and submitted to the Graduate Program Director for forwarding to the Graduate School. Upon Graduate School approval the student will be formally accepted into doctoral candidacy and will be so notified by letter by the Graduate Program Director.

Time Limit and Residency

A student's candidacy will automatically terminate if he/she fails to register appropriately during an academic year. Candidacy for the doctorate automatically terminates after seven consecutive calendar years. A minimum period of seven months must elapse between admission to doctoral candidacy and the receipt of the Ph.D. degree.

University regulations require that as a minimum all doctoral students must enroll for at least twelve graduate credits during each of two consecutive semesters. All full-time doctoral students will readily satisfy this requirement. The Department does not encourage part-time studies in the doctoral program.

Dissertation Submission, Final Defense, and Acceptance

Dissertation research is to be done in residence. The research must be completed, the dissertation written, and the dissertation successfully defended before the Ph.D. is conferred. The primary requirement of a dissertation is to show evidence of high scholarly attainment through original and independent research work. The acceptability of a dissertation depends upon its quality rather than the time and credit hours spent on the research work.

When the dissertation research is completed to the satisfaction of the faculty adviser, the candidate will prepare a draft of the Ph.D. dissertation. This draft should be submitted to the dissertation adviser with sufficient time for critical review and evaluation before scheduling the final defense of the dissertation. After the adviser has gone over the draft and has approved the document, the candidate will prepare the dissertation in the final draft form and will submit a copy to each advisory committee member for critical evaluation at least two weeks before the scheduled final defense. Details concerning the required dissertation format, reproduction, and other regulations for preparing a dissertation are available from the Graduate School.

The doctoral candidate must also prepare a paper, based on the dissertation research, and submit it for publication to a refereed journal, or for presentation at a conference for which papers receive a comparable review, before the final oral defense. Because of the time delay between submittal and possible acceptance, it becomes the responsibility of the student and his/her faculty adviser to pursue the publication of the paper.

A final oral defense of the dissertation is required of every doctoral candidate after he/she has fulfilled all of the other requirements of the doctoral program. This examination is administered by each candidate's advisory committee and is restricted to the content of the dissertation and closely related subject matter. The chairperson of the advisory committee will schedule the final dissertation defense in consultation with the other committee members. All members of the advisory committee should be present at the final defense of the dissertation.

The dissertation defense is presided over by the chairperson of the advisory committee and is open to the university community and to the general public. The dissertation defense must be publicized on a standard form obtained from the Department Office, and posted at least two weeks before the defense date. The Graduate School, the Graduate Office of the College of Engineering and the Department's Graduate Program Director must also be notified at least two weeks in advance of a final dissertation defense.

The dissertation defense includes approximately 45 minutes of oral presentation of the dissertation research by the candidate, followed by questions and comments from members of the advisory committee, other attending faculty, students and others. The dissertation presentation is important and should be well prepared in consultation with the faculty adviser. Visual aids are highly recommended.

At the conclusion of the question and discussion period, all those present other than graduate faculty and the advisory committee members will be excused. The advisory committee will vote regarding the acceptability of the dissertation and its defense, and report to the candidate. At least a 3/4 majority of the committee must concur in the final decision.

If the candidate passes, the advisory committee will complete and sign the dissertation approval page and other departmental forms and forward them to the Graduate Program Director. If the candidate does not pass the final defense of the dissertation, then the advisory committee, in consultation with the Graduate Program Director, will decide upon a future course of action.

There may be major or minor changes required in the dissertation by the committee. These must be made by the candidate and approved by the faculty adviser before the student can be certified for graduation. The final corrected copies must be submitted to the Graduate School by the published due date for the anticipated term of graduation. At least five permanently bound copies of the dissertation must be prepared and submitted on high quality bond paper in accordance with University regulations. One copy is to be provided to the faculty adviser who has directed the study; two copies are to be submitted to the Graduate School for archival storage in the University Library. One copy will be kept in the Department of Civil and Environmental Engineering Library. The remaining copy is to be forwarded to the graduate as a permanent record of his/her accomplishment. Before the Department can certify the candidate to graduate, a receipt indicating submission of five copies for binding must be submitted to the Department. At his/her discretion, the candidate may prepare and bind additional copies for committee members or others.

Completion of Thesis/Dissertation Research

It is expected that the research done for either degree (MSCE/PhD) and the resulting thesis or dissertation will be completed while the student is still in full-time residence, and this is especially to be expected of those students who have received financial aid. Departure before final acceptance of the thesis or dissertation generally results in long delays before completion, in some cases so long that the work has been superseded by the work others and may no longer be acceptable to meet the requirements. **International students must, of course maintain full-time status and remain in residence until all requirements for the degree are met.**

Grade Requirements for Graduation

Almost all work in the Department will result in a grade of A, A-, B+, B, B-, C+, C, C-, or F with the associated quality points of 4.0, 3.67, 3.33, 3.0, 2.67, 2.33, 2.0, 1.67, and 0.0 respectively. The grade of D, i.e., 1, cannot be counted for graduate credit. All graduate course work to be counted towards the degree requirements must be taken for a regular grade, and cannot be taken on a pass/fail basis.