

# 2015-2016 LONG SIGNATURE SHEET



UNC CHARLOTTE

Proposal Number: CEE 20151201

Proposal Title: Establishment of Permanent Course #s for CEE Graduate Courses

Originating Department: Civil & Environmental Engineering (CEE)

TYPE OF PROPOSAL: UNDERGRADUATE \_\_\_\_\_ GRADUATE X UNDERGRADUATE & GRADUATE \_\_\_\_\_  
 (Separate proposals sent to UCCC and Grad. Council)

DATE RECEIVED	DATE CONSIDERED	DATE FORWARDED	ACTION	SIGNATURES
			Approved	<u>DEPARTMENT CHAIR</u>  John Daniels
			Approved	<u>COLLEGE CURRICULUM COMMITTEE CHAIR</u>  TAO HONG
			Approved	<u>COLLEGE FACULTY CHAIR (if applicable)</u>
	1/18/16	1/18/16	Approved	<u>COLLEGE DEAN</u>  Robert E. Johnson
			Approved	<u>GENERAL EDUCATION</u> (if applicable; for General Education courses)
			Approved	<u>UNDERGRADUATE COURSE &amp; CURRICULUM COMMITTEE CHAIR</u> (for undergraduate courses only)
4/28/16	3/1/16	7/8/16	Approved	<u>GRADUATE COUNCIL CHAIR</u> (for graduate courses only)  Alan R. Freitag Rob Roy McGregor
				<u>FACULTY GOVERNANCE ASSISTANT</u> (Faculty Council approval on Consent Calendar)
				<u>FACULTY EXECUTIVE COMMITTEE</u> (if decision is appealed)



# UNC CHARLOTTE

## **LONG FORM COURSE AND CURRICULUM PROPOSAL**

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To: Graduate Committee

From: Department of Civil & Environmental Engineering (CEE)

Date: December 1, 2015

Re: Proposal for New Graduate Courses (Permanent Numbers)

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### **A. PROPOSAL SUMMARY.**

#### **SUMMARY.**

The CEE Department proposes to add the following course to its graduate curriculum leading to the MSCE and MSE degrees.

CEGR 6167 Discrete Choice Modeling

The aforementioned course has been taught once as “topics” courses (CEGR 6090). Copy of syllabus for the course listed above is shown in Appendix A.

The proposed course has been well-received by students and well-regarded by the faculty in the transportation engineering area. The concepts and topics learned from this course would have our students be well-prepared to better solve real-world transportation engineering problems. Therefore, permanent course number and permanent catalog description are requested for the aforementioned course.

The course number was identified maintaining consistency with CEE past practices and recommended guidelines.

Moreover, the following changes are recommended based on discussions amongst faculty of respective concentrations.

- 1) Remove “CEGR 5184: Highway Safety” from the catalog listing. There is no plan to offer this course in the near future. This course was not taught since fall 2005. The Transportation Engineering faculty are currently offering an advanced course (“CEGR 6164: Traffic Safety”) for graduate students on this topic.
- 2) Change CEGR 5273 title to “Engineering Ground Improvement”. The title / name in the current catalog is “Soil Improvement”. To better reflect the content discussed as a part of this course, “CEGR 4273: Soil Improvement” course title was changed to “CEGR 4273: Engineering Ground Improvement” recently. The proposed change is required to be consistent with CEGR 4273 new course title.
- 3) Change catalog description to reflect that only one outside the concentration course is allowed with prior approval from the adviser and the Graduate Program Director. The CEE department hired 12 new tenure-track faculty and non-tenure track lecturers during the last ten years. Adequate number of courses are being offered at 5000- and 6000-level each semester. These courses cover a wide range of topics pertaining to each concentration. Further, a list of required and recommended courses is generated for each concentration (see Appendix B for details). The proposed change is required to ensure that enrollment numbers are high in the courses taught by the CEE department faculty and to advise graduate students as per the list generated recently. Also, the change would limit graduate students opting to take courses outside and not relevant to their concentration for reasons outside the scope of this proposal.
- 4) CEGR 6891: Graduate Master Project. Currently, CEGR 6892 is used for both “Individualized Study and Project” and “Graduate Master Project”. This is causing confusion and, at times, leading to inappropriate reflection of the actual focus of the “Graduate Master Project” (example, a graduate student wants to register for “Graduate Master Project” but incorrectly registers for “Individualized Study and Project” section number). The requirements to complete “Graduate Master Project” are different from “Individualized Study and Project”. Graduate students taking “Master Project” has to form a Committee, have the Committee review their work, defend the project and submit the final deliverable unlike the “Individual Study and Project” where the work and deliverable is reviewed only by the instructor. The change is required to minimize the confusion to enroll in the correct course and have graduate students meet the requirements based on the registered course.
- 5) CEGR 6999. Graduate Master Additional Work. Several students are registering for additional thesis / project hours than required due to incompleteness of their Thesis, Project or Comprehensive Exam in a timely manner. Regular grade for this additional effort leads to inaccurate computation of their cumulative GPA (compared to other graduate students who complete their work in a timely manner and do not have to take extra credit hours). Therefore, this course number is created for students to initiate or continue an individual investigation culminating in the preparation and presentation of a deliverable (could be part of Master Thesis or Project), upon meeting the 30-credit hours degree requirement. This course will be graded on a Pass/Unsatisfactory or IP basis.

#### **B. JUSTIFICATION.**

The CEE department hired 12 new tenure-track faculty and non-tenure track lecturers during the last ten years. The new faculty added breadth and depth to the expertise of the department. They

offered several new courses to introduce our students to the civil engineering topics and prepare them for their future.

The aforementioned course was taught once in 2015 by Dr. Fan. The course and discussions provided ample opportunities for CEE graduate students to explore the concepts. There is growing demand and need to offer this course regularly, the best solution apparent to solve this problem is to have a permanent course number and title.

**C. IMPACT.**

Graduate students admitted to MSCE and MSE programs and in good standing will be served by this proposal. Good-standing graduate students who meet the prerequisites / corequisites for the course are eligible to register. These students are expected to have adequate fundamentals, concepts, and credentials to enroll and successfully complete the aforementioned courses.

The proposal or proposed course does not have any effect on degree completion requirements.

It is anticipated that 5 to 10 graduate students may take the proposed course when offered. The proposed course will be offered based on demand. The Focus Area Improvement Team (FAIT) leader will work with faculty to identify suitable semester to offer the course and advertise as needed (at the start of previous semester) so that students can plan in advance to take the courses. The content and other details are provided in the enclosed graduate syllabus for the proposed course (Appendix A).

The addition of the proposed course and other changes will have an effect on information in the CEE portion of the Graduate Catalog. Description, as required, is added for the proposed course. The other recommended changes to the Graduate Catalog are also shown in Appendix B.

**III. RESOURCES REQUIRED TO SUPPORT PROPOSAL.**

**A. PERSONNEL.**

No new faculty are needed to teach the course. Current faculty who taught the course in the past are indicated in the parenthesis for each proposed course.

CEGR 6167 Discrete Choice Modeling (Wei Fan)

Other faculty in the CEE Department has the knowledge and expertise to supplement and teach the proposed course.

**B. PHYSICAL FACILITY.** CEE has adequate space available to teach the aforementioned course.

**C. EQUIPMENT AND SUPPLIES:** No additional funding is allocated for any special equipment or supplies needed to teach the listed courses.

**D. COMPUTER.** Software installed in CEE teaching/research labs or available on Mosaic are required by students and/or faculty for the listed course. The software and the number of licenses possessed by CEE are adequate and meet the anticipated needs.

E. **AUDIO-VISUAL.** No audio-visual facilities beyond the standard classroom podiums are needed to teach the courses.

F. **OTHER RESOURCES.** No new/added resources (travel, communication, printing and binding) are required, hence, costs were not estimated or requested.

G. **SOURCE OF FUNDING.** No additional sources are required.

#### **IV. CONSULTATION WITH THE LIBRARY AND OTHER DEPARTMENTS OR UNITS**

##### **A. LIBRARY CONSULTATION.**

A copy of written consultation with the Library Reference Staff (Jeffrey McAdams) is attached for the proposed course (Appendix C).

##### **B. CONSULTATION WITH OTHER DEPARTMENTS OR UNITS.**

Consultation with other departments or units was not necessary as the proposed course was offered in the past, well received by CEE graduate students, and intended primarily for CEE graduate students.

#### **V. INITIATION, ATTACHMENTS AND CONSIDERATION OF THE PROPOSAL**

##### **A. ORIGINATING UNIT.**

Discussions regarding the proposed course contained in this proposal were initiated during the 2014-2015 academic year. The proposed course was reviewed by the respective FAIT faculty at meetings held during fall 2015. All faculty members who participated in the FAIT discussions voted in favor of the proposed course. As needed, this was followed by preparation of long-form proposal.

##### **B. CREDIT HOUR.**

Review statement and check box once completed:

- X     The appropriate faculty committee has reviewed the course outline/syllabus and has determined that the assignments are sufficient to meet the University definition of required 3 credit hours.

##### **C. ATTACHMENTS.**

###### **1. CONSULTATION:**

Consultation with other departments or units was not necessary as the proposed course was offered in the past, widely received by CEE graduate students, and intended primarily for CEE graduate students.

###### **2. COURSE OUTLINE/SYLLABUS:**

Syllabi with necessary details, as required for graduate courses, is provided for the proposed course in Appendix A.

3. **PROPOSED CATALOG COPY:** Copy should be provided for all courses in the proposal. Include current subject prefixes and course numbers, full titles, credit hours, prerequisites and/or corequisites, concise descriptions, and an indication of when the courses are to be offered as to semesters and day/evening/weekend. Copy and paste the

[current catalog copy](#) and use the Microsoft Word “track changes” feature (or use red text with “~~strikethrough~~” formatting for text to be deleted, and adding blue text with “underline” formatting for text to be added).

a. For a new course or revisions to an existing course, check all the statements that apply:

- This course will be cross listed with another course.
- There are prerequisites for this course.
- There are corequisites for this course.
- This course is repeatable for credit.
- This course will increase/decrease the number of credits hours currently offered by its program.
- This proposal results in the deletion of an existing course(s) from the degree program and/or catalog.

For all items checked above, applicable statements and content must be reflected in the proposed catalog copy.

b. If overall proposal is for a new degree program that requires approval from General Administration, please contact the [facultygovernance@uncc.edu](mailto:facultygovernance@uncc.edu) for consultation on catalog copy.

A copy of CEE portion of the Graduate Catalog with track changes is enclosed as Appendix B.

4. ACADEMIC PLAN OF STUDY (UNDERGRADUATE ONLY): Does the proposed change impact an existing Academic Plan of Study?
  - Yes. If yes, please provide updated [Academic Plan of Study](#) in template format.
  - No.
5. STUDENT LEARNING OUTCOMES: Does this course or curricular change require a change in SLOs or assessment for the degree program?
  - Yes. If yes, please detail below.
  - No.
6. TEXTBOOK COSTS: It is the policy of the Board of Governors to reduce textbook costs for students whenever possible. Have electronic textbooks, textbook rentals, or the buyback program been considered and adopted?
  - Yes. Faculty will make every effort to reduce the costs of textbooks for students by requiring online or free download texts.
  - No.

# APPENDIX A.

## CEGR 6167 Discrete Choice Modeling

**Proposed and to be taught by:**

**Dr. Wei Fan, Associate Professor of Civil & Environmental Engineering**

### **Graduate Catalog – Information and Description**

**CEGR 6167. Discrete Choice Modeling. (3). Prerequisites: CEGR 3161 or Consent of the instructor, graduate student status.** Introduction to elements of the choice process; utility-based choice theory; principles of binary choice models; multinomial logit models; nested logit models; and ordered response models. (*On demand*)

**# Credit Hours: 3**

**Frequency:** On-demand

**Prerequisites:** CEGR 3161

### **Course Objectives**

Econometric discrete choice analysis is an essential component of studying individual choice behavior and is used in many diverse fields to model consumer demand for commodities and services. Typical examples of the use of econometric discrete choice analysis include studying labor force participation, professional occupation, residential location, and house tenure status (owning versus renting) in the economic, geography, and regional science fields; choice of travel mode, destination and car ownership level in the travel demand field; purchase incidence and brand choice in the marketing field; and choice of marital status and number of children in sociology.

In this Discrete Choice Modeling in Transportation course, students will be provided with an understanding of the theory and models of individual choice behavior. The course builds on econometric modeling approaches to develop guidelines for the formulation and estimation of models of choice behavior and their use in service and product design, marketing and prediction. Practical problems (using the statistical software SAS for estimation) will be assigned to give students familiarity with models discussed in class. These problems will focus on choice behavior in the context of travel demand analysis. However, the class instruction/discussion will be general and will focus on theory and modeling methodology for application to any discrete choice context.

**Instructional Method:** Lecture

**Evaluation and Grading**

Grading Scale: A=90-100, B=80-89.9, C=70-79.9, U=0-69.9.

Homework	1200 (60%)
Professional Practice Grade	200 (10%)
Final Project**	600 (30%)
	2,000 (100%)

\*\* Project will include working with the instructor to identify a topic and scope of work, submit the final report and share findings through a presentation with the class.

**Textbook**

A Self-Instructing Course (SIC) in Mode Choice Modeling: Multinomial and Nested Logit Models, prepared for U.S. Department of Transportation, Federal Transit Administration, by Frank S. Koppelman and Chandra Bhat, 2006, which is available for free download online ([http://www.caee.utexas.edu/prof/bhat/COURSES/LM\\_Draft\\_060131Final-060630.pdf](http://www.caee.utexas.edu/prof/bhat/COURSES/LM_Draft_060131Final-060630.pdf)).

Additional background and more detail on specific topics.

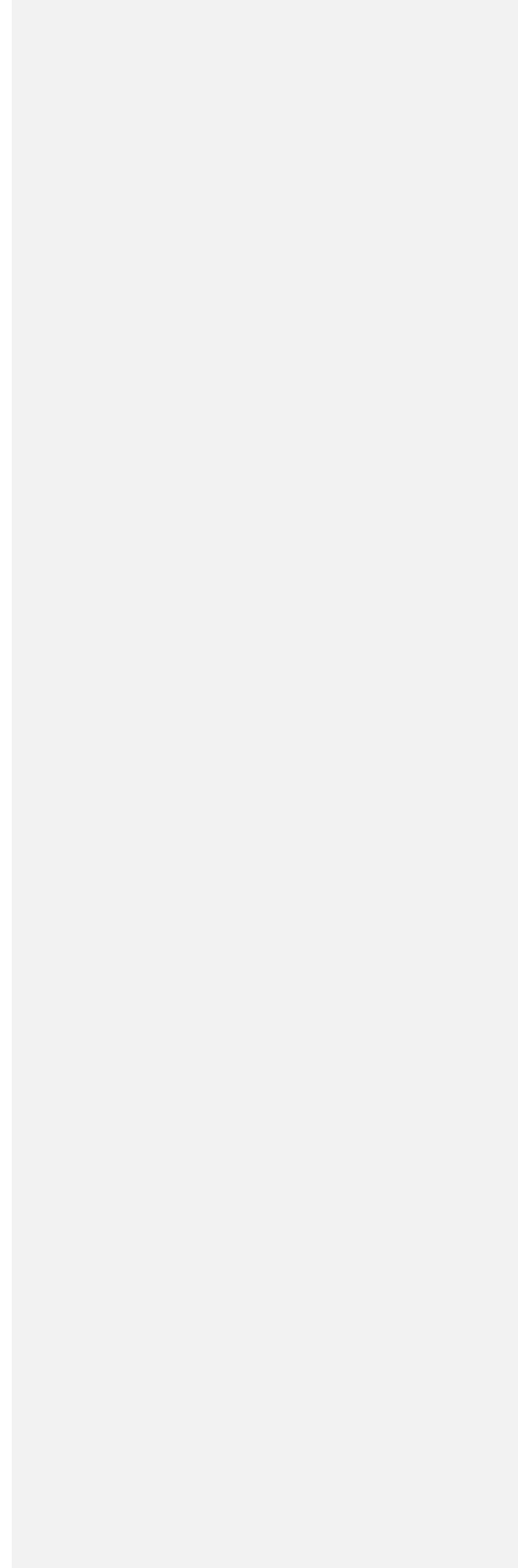
Moshe Ben-Akiva and Steven R. Lerman (1985). Discrete Choice Analysis: Theory and Application to Travel Demand.

**Course Outline**

- Elements of Choice Process
- Utility-based Choice Theory
- Binary Choice Models
- Multinomial Logit Models
- Nested Logit Models
- Ordered Response Models



## **APPENDIX B**



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# Civil and Environmental Engineering

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- **M.S. in Civil Engineering**
- **M.S. in Engineering**
- **Ph.D. in Infrastructure and Environmental Systems** (*see the Infrastructure and Environmental Systems heading*)

**Department of Civil and Environmental Engineering**  
cee.uncc.edu

**Graduate Program Director**  
Dr. Srinivas S. Pulugurtha

## Graduate Faculty

Dr. James E. Amburgey, Associate Professor  
Dr. James D. Bowen, Associate Professor

**Dr. Nicole Braxton, Assistant Professor**

Dr. Shen-en Chen, P.E., Professor  
Dr. John L. Daniels, P.E., Department Chair and Professor  
Dr. Venkata R. Duddu, Faculty Associate  
Dr. Wei Fan, P.E., Associate Professor  
Dr. Janos I. Gergely, S.E., P.E., Associate Professor

Dr. Rajaram Janardhanam, Professor  
Dr. Martin R. Kane, P.E., Associate Professor

Dr. Olya **S. Keen**, Assistant Professor

Dr. Milind V. Khire, P.E., Professor

**Dr. Mariya Munir, Assistant Professor**

Dr. David Naylor, P.E., Lecturer  
Dr. Vincent O. Ogunro, Associate Professor  
Dr. Shubhashini Oza, Faculty Associate  
Dr. Miguel A. Pando, Associate Professor  
Dr. Youngjin Park, Faculty Associate  
Dr. Srinivas S. Pulugurtha, P.E., Professor  
Dr. William Saunders, P.E., Lecturer

**Dr. Mei Sun, Assistant Professor**

Dr. Brett Q. Tempest, Assistant Professor  
Dr. Kimberly A. Warren, Associate Professor  
Dr. David C. Weggel, P.E., Professor  
Dr. Matthew J. Whelan, Assistant Professor  
Dr. Erika Weber, P.E., Lecturer  
Dr. Jy S. Wu, P.E., P.H., Professor  
Dr. David Young, P.E., Professor

*P.E. = Professional Engineer*  
*P.H. = Professional Hydrologist*  
*S.E. = Structural Engineer*

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### Programs of Study

The Department of Civil and Environmental Engineering (CEE) provides opportunities for discipline-specific and multidisciplinary graduate-level education in Civil and Environmental Engineering and closely related areas. Advanced coursework and research are used to enhance professional development, improve technical competency, and initiate a life-long learning experience. The Department has ongoing collaborative research and student exchange programs with several international institutions.

The Department offers graduate studies leading to a master's degree (MSCE or MSE) in five areas of concentration:

- 1) Environmental and water resources engineering
- 2) Geo-environmental engineering
- 3) Geotechnical engineering
- 4) Structural engineering
- 5) Transportation engineering

Doctoral studies leading to the Ph.D. in Infrastructure and Environmental Systems (INES) are available in an interdisciplinary, inter-college program. See the *Infrastructure and Environmental Systems* heading for details.

## MASTER OF SCIENCE IN CIVIL ENGINEERING (MSCE) AND MASTER OF SCIENCE IN ENGINEERING (MSE)

### Admission Requirements

In addition to the general requirements for admission to the Graduate School, the Department of Civil and Environmental Engineering seeks the following from applicants to the Master's programs in Civil Engineering:

- An earned undergraduate degree in Civil Engineering for the MSCE master's program or a closely related field for the MSE master's program
- An undergraduate GPA of 3.0 or better
- A satisfactory score from the Aptitude Portion of the GRE
- Three letters of recommendation
- An acceptable TOEFL score as required by UNC Charlotte for international students
- And any other appropriate credentials as required by the Graduate School

### Additional Admission Requirements

- Admission to the MSE program ~~may require~~ [completion-remediation](#) of certain deficiencies as specified by [the Department for](#) each area of concentration
- Admission to the Early Entry Program requires a minimum GPA of 3.2, completion of at least 75 hours toward the BSCE degree, and acceptance by the Graduate School to the MSCE program at UNC Charlotte.

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**Early Entry Program**

Undergraduate students at UNC Charlotte with outstanding academic performance, and satisfying the requirements described above, may be admitted to the Early Entry Program to pursue graduate study while completing the undergraduate degree requirements. Early Entry students are dually enrolled with both undergraduate and graduate status, may request two graduate Civil Engineering (CEGR) courses to be applied to both their graduate and undergraduate programs (double-counting), and may complete up to 15 credits toward their MS degree prior to graduating with their BSCE degree.

**Application Deadline**

Applications for admission must be submitted online directly to the Graduate School. They may be submitted any time prior April 1 for Fall admission, and October 1 for Spring admission. To be considered for assistantships and tuition grants for the following academic year, students should apply by February 15 because the Department makes the first round of award decisions by March 15.

**Assistantships**

Research and teaching assistantships are available from the Department on a competitive basis to highly qualified applicants/students. Interested students are encouraged to directly contact faculty in their area of interest for research assistantships.

**Tuition Grants**

Tuition grants including Non-Resident Tuition Differentials and Resident Tuition Aids are available on a competitive basis for both out-of-state and in-state students, respectively.

**Degree Requirements**

A minimum of 30 approved graduate credit hours is required for graduation. At least half of the approved graduate credit hours must be in courses numbered 6000 or above. A student may fulfill the 30-hour requirement by pursuing one of the three study options: (a) 24 hours of coursework plus 6 hours of thesis, (b) 27 hours of coursework plus 3 hours of a directed project, or (c) 30 hours of coursework and a comprehensive examination. Each student is limited to one individual study class within the 30-hour requirement.

**Concentration Requirements**

Required core courses for the five concentrations are listed below.

**Environmental and Water Resources Engineering Concentration**

CEGR 6243 Physical Processes in Environmental Systems (3)

CEGR 6245 Chemical and Biological Processes in Environmental Systems (3)

**Geo-Environmental Engineering Concentration**

CEGR 5145 Groundwater Resources Engineering (3)

CEGR 5264 Landfill Design and Site Remediation (3)

**Geotechnical Engineering Concentration**

CEGR 5270 Earth Pressures and Retaining Structures (3)

CEGR 6251 Foundation Engineering (3)  
 CEGR 6254 Experimental Soil Mechanics (3)  
 CEGR 6255 Slope Stability and Earth Structures (3)  
 CEGR 6268 Advanced Soil Mechanics (3)

**Structural Engineering Concentration**

CEGR 5108 Finite Element Analysis and Applications (3)  
 CEGR 5222 Structural Steel Design II (3)  
 CEGR 5224 Advanced Structural Analysis (3)  
 CEGR 5226 Reinforced Concrete Design II (3)  
 CEGR 6129 Structural Dynamics (3)

**Transportation Engineering Concentration**

CEGR 5161 Advanced Traffic Engineering (3)  
 CEGR 5162 Transportation Planning (3)  
 CEGR 5185 Geometric Design of Highways (3)  
 CEGR 6161 Traffic Control and Operation (3)  
 GEOG 6100 Quantitative Methods in Geography (3)

Additional recommended courses (does not include **CEGR 6891**, CEGR 6892, or CEGR 6991) for each concentration are shown next in the table.

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Concentration	Additional Recommended Courses
Environmental and Water Resources Engineering	CEGR 5141: Process Engineering, CEGR 5142: Water Treatment Engineering, CEGR 5143: Solid Waste Management, CEGR 5144: Engineering Hydrology, CEGR 5145: Groundwater Resources Engineering, CEGR 5146: Advanced Engineering Hydraulics, CEGR 5147: Stormwater Management, CEGR 5234: Hazardous Waste Management, CEGR 5235: Industrial Pollution Control, CEGR 5237: Environmental Risk Management, CEGR 5241: Chemical Processes in Water and Wastewater Treatment, CEGR 5242: Wastewater Treatment Plant Design, CEGR 5243: Topics in Environmental Health, CEGR 5247: Sustainability, CEGR 6141: Water Quality Modeling, CEGR 6142: Bioenvironmental Engineering, CEGR 6144: Environmental Biotechnology, CEGR 6145: Waste Incineration, CEGR 6146: Advanced Groundwater Analysis, CEGR 6147: Watershed Modeling, CEGR 6148: Water Conservation, CEGR 6149: Watershed Analysis, CEGR 6171: Air Quality Control, CEGR 6172: Air Dispersion Modeling, CEGR 6173: Environmental Aquatic Chemistry, CEGR 6244: Chemical Fate and Transport, and CEGR 5090 / 6090 special topics courses in environmental and water resources engineering
Geo-environmental Engineering	CEGR 5270: Earth Pressure and Retaining Structures, CEGR 5271: Pavement Design, CEGR 5272: Design with Geosynthetics, CEGR 5273: Soil Improvement, CEGR 5274: Site Characterization, CEGR 5278: Geotechnical Engineering II, CEGR 6146: Advanced Groundwater Analysis, CEGR 6243: Physical Processes in Environmental Systems,

	CEGR 6244: Chemical Fate and Transport, CEGR 6245: Chemical & Biological Processes in Environmental Systems, CEGR 6251: Foundation Engineering, CEGR 6252: Soil Dynamics and Earthquake Engineering, CEGR 6254: Experimental Soil Mechanics, CEGR 6255: Slope Stability and Earth Structures, CEGR 6268: Advanced Soil Mechanics and CEGR 5090 / 6090 special topics courses in geo-environmental engineering
Geotechnical Engineering	CEGR 5145: Groundwater Resources Engineering, CEGR 5264: Landfill Design and Site Remediation, CEGR 5271: Pavement Design, CEGR 5272: Design with Geosynthetics, CEGR 5273: <a href="#">Engineering Ground Improvement</a> <a href="#">Soil Improvement</a> , CEGR 5274: Site Characterization, CEGR 5278: Geotechnical Engineering II, CEGR 6252: Soil Dynamics and Earthquake Engineering, and CEGR 5090 / 6090 special topics courses in geotechnical engineering
Structural Engineering	CEGR 5121: Prestressed Concrete Design, CEGR 5123: Bridge Design, CEGR 5125: Forensic Engineering, CEGR 5126: Codes, Nodes and Loads, CEGR 5127: Green Building and Integrative Design, CEGR 5128: Matrix Methods of Structural Analysis, CEGR 5223: Timber Design, CEGR 6122: Advanced Topics in Structural Steel, CEGR 6124: Masonry Design, CEGR 6125: Structural Strengthening, CEGR 6126: Analysis of Plates and Shells, CEGR 6127: Fracture Mechanics and Fatigue, CEGR 6128: Structural Optimization, CEGR 6222: Experimental Structural Mechanics and Nondestructive Evaluation, MEGR 6141: Theory of Elasticity I and CEGR 5090 / 6090 special topics courses in structural engineering
Transportation Engineering	CEGR 5171: Urban Public Transportation, CEGR 5181: Human Factors in Traffic Engineering, CEGR 5182: Transportation Environmental Assessment, CEGR 5183: Traffic Engineering Studies, <a href="#">CEGR 5184: Highway Safety</a> , CEGR 5262: Traffic Engineering, CEGR 5271: Pavement Design, CEGR 6162: Computer Applications for Transportation Engineers, CEGR 6163: GIS for Civil Engineers, CEGR 6164: Traffic Safety, CEGR 6165: Urban Systems Engineering, CEGR 6166: Urban Transportation Networks, <a href="#">CEGR 6167: Discrete Choice Modeling</a> , CEGR 6181: Traffic Flow Theory, CEGR 6182: Transportation System Analysis and CEGR 6261: Traffic Signal Control Systems, and CEGR 5090 / 6090 special topics courses in transportation engineering

*Note: Undergraduate students who have taken any of the courses listed above, or equivalent material, as part of their undergraduate program need not take the corresponding 5000-level graduate courses. Instead, they may choose other graduate courses as part of their master's degree plan of study. Courses without designated course numbers are currently being offered as Special Topic classes with appropriate course numbers yet to be provided.*

#### **Admission to Candidacy Requirements**

Each student is required to submit a Plan of Study to the Graduate Program Director before completing 18 hours of graduate credits. The Plan of Study will streamline coordination of the

required coursework and research work between the student and his/her advisor before submitting the Admission to Candidacy.

Upon completion of a substantial amount of graduate work, each student must file an Admission to Candidacy form to the Graduate School by the filing date, typically at the beginning of the semester for graduation specified in the University Academic Calendar.

### **Application for Degree**

Students preparing to graduate must submit an online Application for Degree by the filing date specified in the University Academic Calendar. If a student does not graduate in the semester identified on the Application for Degree, then the student must update his/her Admission to Candidacy and submit a new Application for Degree for graduation in a subsequent semester.

### **Transfer Credit**

The Department accepts the transfer of **related** graduate courses (6 credits maximum) taken at another institution or from UNC Charlotte prior to admission to the master's program in Civil Engineering.

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### **Electives**

With advisor and Graduate/or Program Committee's-Director's approval, a maximum of ~~two~~ one graduate courses (outside CEGR or within CEGR) related to thesis topic or project topic or student's concentration may be incorporated into the 30-hour requirement. A student with a non-CEGR background is encouraged to fulfill the 30-hour requirement by taking all CEGR courses.

### **Advising**

Each student is assigned an initial academic advisor. Upon developing a program of study, the student shall be supervised by his/her graduate advisor and a program committee.

### **Program Committee**

The Program Committee shall consist of at least three UNC Charlotte graduate faculty members. At most one graduate faculty member (CEGR or non-CEGR) from outside the student's concentration may serve as a member of the Program Committee. The student's CEE graduate advisor shall chair the committee.

### **Capstone Experiences**

Students pursuing a master's degree in Civil and Environmental Engineering have three options to complete the 30-credit hour program. Students may elect to complete 24 credit hours of coursework plus 6 credit hours of thesis, **CEGR 6991**; 27 credit hours of coursework plus 3 credit hours of a directed project, **CEGR 6891**; or 30 credit hours of coursework plus a written and/or oral comprehensive examination. All three options require the formation of a program committee as described above. The thesis and project options require students to submit a written thesis or project report, and orally defend their work before their program committee.

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A student's comprehensive exam may be taken once all core courses are completed, and at least 18 hours of graduate coursework are either completed or in progress. Core courses taken at the graduate level may be included in the 18 hours. The student's graduate advisor and the

examining committee coordinate the examination (typically offered once in the Fall semester and once in the Spring semester), preparing the exam with the assistance of members of the student's Program Committee. The exam measures the student's mastery of theories and applications in core courses and/or in the selected area of specialization within the discipline. Students have only two attempts to pass the examination. All students passing the written examination are assessed further on their oral communication effectiveness.

### **Research Opportunity/Experience**

Students in Civil and Environmental Engineering enjoy a curriculum with opportunities for interdisciplinary research, study abroad, and active participation in a growing research program. Programs of study can be tailored to suit individual needs and interests. The CEE website ([cee.uncc.edu](http://cee.uncc.edu)) provides current areas of research conducted by the Civil and Environmental Engineering faculty.

### **Program Learning Outcomes**

Students completing master's degree will demonstrate abilities to analyze and evaluate advanced topics in engineering, and to communicate technical information effectively. Achievement of these outcomes will prepare students to function professionally in their chosen careers.

Program learning outcomes for doctoral students are described in the "Infrastructure and Environmental Systems" section of this *Catalog*.

## **COURSES IN CIVIL AND ENVIRONMENTAL ENGINEERING (CEGR)**

**CEGR 5090. Special Topics in Civil Engineering. (1-4)** Study of specific new areas emerging in the various fields of civil engineering. *May be repeated for credit. (On demand)*

**CEGR 5108. Finite Element Analysis and Applications. (3)** Prerequisites: CEGR 4224 and permission of department. Finite element method and its application to engineering problems. Application of displacement method to plane stress, plane strain, plate bending and axisymmetrical bodies. Topics include: dynamics, fluid mechanics, and structural mechanics. *(On demand)*

**CEGR 5121. Prestressed Concrete Design. (3)** Prerequisites: CEGR 3225, CEGR 4224, and permission of department. Analysis and design of prestressed components and systems, including materials and systems for prestressing, loss of prestress, flexural and shear design in accordance with current building codes, analysis of indeterminate prestressed systems, and control of camber, deflection and cracking. *(On demand)*

**CEGR 5123. Bridge Design. (3)** Prerequisites: CEGR 3221, CEGR 3225, and permission of department. Review of bridge design codes and loadings; superstructure and substructure design of short, intermediate, and long span bridges constructed of steel and concrete; earthquake design; segmental and cable-stayed bridges. *(On demand)*

**CEGR 5125. Forensic Engineering. (3)** Prerequisites: CEGR 3122 and permission of department. Evaluation of structural and construction failures through review of case studies,



types and causes of failures, and relevant methods of failure investigation; analysis of failures occurring in a variety of structures, involving a variety of materials, and resulting from a variety of causes; development, expression, and defense of opinions and conclusions, orally and in writing, with an understanding of the impact on the legal process surrounding a failure claim. *(On demand)*

**CEGR 5126. Codes, Loads, and Nodes. (3)** Prerequisites: CEGR 3122 and permission of department. Building systems and components; code requirements according to the latest ASCE Standard 7 pertaining to buildings and other structures; gravity load analysis including dead, live, roof live and snow loads; lateral load analysis focusing on wind and seismic forces, and applied to the main lateral load resisting systems; software applications using the SAP2000 tool, with 2-D and 3-D models loaded with gravity and lateral loads. *(On demand)*

**CEGR 5127. Green Building and Integrative Design. (3)** Prerequisites: CEGR 3122 and permission of department. Prepares students to function in multidisciplinary design teams working to produce buildings, sites and coupled environmental-infrastructure systems with resilience and sustainability as design priorities. Focus areas include: civil engineering aspects of energy use, material use, emissions generation and design strategies for integrated design. *(On demand)*

**CEGR 5128. Matrix Methods of Structural Analysis. (3)** Prerequisite: permission of department. Derivation of the basic equations governing linear structural systems. Application of stiffness and flexibility methods to trusses and frames. Solution techniques utilizing digital computer. *(On demand)*

**CEGR 5141. Process Engineering. (3)** Prerequisites: CEGR 3141 and permission of department. Applications of material and energy balance principles to the study of chemical, biological and environmental engineering processes. Overview of applied biotechnology, engineering thermodynamics and kinetics. *(On demand)*

**CEGR 5142. Water Treatment Engineering. (3)** Prerequisites: CEGR 3141 and permission of department. Analysis and design of water and wastewater treatment processes including: physical, chemical and biological treatment. Computer-aided design of treatment systems. *(On demand)*

**CEGR 5143. Solid Waste Management. (3)** Prerequisites: CEGR 3141 and permission of department. Solid waste management, sources, generation rates, processing and handling, disposal, recycling, landfill closures, and remedial actions for abandoned waste sites. *(On demand)*

**CEGR 5144. Engineering Hydrology. (3)** Prerequisites: CEGR 3143 and permission of department. A quantitative study of the various components of the water cycle, including precipitation, runoff, ground water flow, evaporation and transpiration, and stream flow. Hydrograph analysis, flood routing, frequency and duration, reservoir design, and computer applications. *(On demand)*

**CEGR 5145. Groundwater Resources Engineering. (3)** Prerequisites: CEGR 3143 and permission of department. Overview of hydrological cycle. Principles of groundwater flow and well hydraulics. Regional groundwater flow and flow nets. Water chemistry and contamination. Applications of groundwater modeling. *(On demand)*

**CEGR 5146. Advanced Engineering Hydraulics. (3)** Prerequisites: CEGR 3143 and permission of department. Problems of liquids as applied in civil engineering; open channel flow; dams and spillways; water power; river flow and backwater curves; pipe networks, fire flow, sewage collection, groundwater, computer applications. *(On demand)*

**CEGR 5147. Stormwater Management. (3).** Prerequisites: CEGR 3143 and CEGR 3141, Consent of the instructor, graduate student status. Introduction to the impacts and water quality parameters due to urbanization. Develop a numerical model to analyze water stormwater impacts and evaluate different mitigation methods. Understand and utilize the guiding principles of low impact design (LID) and evaluate the available BMPs and understand their limitations. *(On demand)*

**CEGR 5161. Advanced Traffic Engineering. (3)** Prerequisites: CEGR 3161 and permission of department. Analysis of basic characteristics of drivers, vehicles and roadway that affect the performance of road systems. Stream flow elements, volume, density, speed. Techniques of traffic engineering measurements, investigations and data analysis, capacity analysis. Intersections, accidents, parking. *(On demand)*

**CEGR 5162. Transportation Planning. (3)** Prerequisites: CEGR 3161 and permission of department. Urban transportation; travel characteristics of urban transportation systems; analysis of transportation-oriented studies; analytic methods of traffic generation, distribution, modal split and assignment; traffic flow theory. *(On demand)*

**CEGR 5171. Urban Public Transportation. (3)** Prerequisites: CEGR 3161 and permission of department. Planning, design, and operation of bus, rail, and other public modes. Relationship between particular modes and characteristics of urban areas. Funding, security and other administrative issues. *(On demand)*

**CEGR 5181. Human Factors in Traffic Engineering. (3)** Prerequisites: CEGR 3161 and permission of department. Study of the driver's and pedestrian's relationship with the traffic system, including roadway, vehicle and environment. Consideration of the driving task, driver and pedestrian characteristics, performance and limitations with regard to traffic facility design and operation. *(On demand)*

**CEGR 5182. Transportation Environmental Assessment. (3)** Prerequisite: permission of department. A study of the environmental impact analysis and assessment procedures for transportation improvements. Route location decisions. Noise, air quality, socio-economic, and other impacts. *(On demand)*

**CEGR 5183. Traffic Engineering Studies. (3)** Prerequisites: CEGR 3161 and permission of department. Introduction to the traffic engineering studies most used by traffic engineers including data collection techniques, statistical analysis procedures, report writing and presentation. One hour of lecture and three hours of laboratory per week. *(On demand)*

**CEGR 5184. Highway Safety. (3)** Prerequisites: CEGR 3161 and permission of department. Engineering responses at the state and local levels to the problem of highway safety. Extent of the highway safety problem, elements of traffic accidents, common accident countermeasures, collection and analysis of accident data, evaluation of safety-related projects and programs, and litigation issues. *(On demand)*

**CEGR 5185. Geometric Design of Highways. (3)** Prerequisites: CEGR 3161 and permission of department. Theory and practice of geometric design of highways including intersections, interchanges, parking and drainage facilities. Driver ability, vehicle performance, safety and economics are considered. Two hours of lecture and three laboratory hours per week. *(On demand)*

**CEGR 5222. Structural Steel Design II. (3)** Prerequisites: CEGR 3221 and permission of department. Analysis and design of structural steel components and systems with emphasis on theories necessary for a thorough understanding of the design of complete structures. Compression members affected by local buckling, beams with lateral-torsional buckling, continuous beams and beam columns are covered. Welded and bolted connections. Current AISC Specifications used. *(On demand)*

**CEGR 5223. Timber Design. (3)** Prerequisites: CEGR 3122 and permission of department. Principles of timber design. Design of simple timber structures subjected to gravity loads and lateral forces. Computation of design loads; formulation of structural systems; design/analyze structural components and connections; structural system analysis of timber structures. Analysis of light commercial and residential structures. *(On demand)*

**CEGR 5224. Advanced Structural Analysis. (3)** Prerequisites: CEGR 3122 and permission of department. A continuation of CEGR 3122. Methods to determine deflections in structural members, including moment area, conjugate beam, virtual work, and Castigliano's theorem. Analyze statically indeterminate structures, including approximate method, slope deflection, moment distribution, and matrix stiffness methods. Project to compare analysis techniques and introduce use of structural analysis computer programs. *(On demand)*

**CEGR 5226. Reinforced Concrete Design II. (3)** Prerequisites: CEGR 3225 and permission of department. Analysis and design of reinforced concrete components and systems with emphasis on the fundamental theories necessary for a thorough understanding of concrete structures. Concentrically loaded slender columns, slender columns under compression plus bending. Wall footings and column footings. Analysis of continuous beams and frames. Total design project involving the analysis and design of a concrete structure. Current ACI Specifications used. *(On demand)*

**CEGR 5234. Hazardous Waste Management. (3)** Prerequisites: CEGR 3141 and permission of department. Integration of scientific and engineering principles with legislation, regulation and technology in the management of hazardous wastes. Study of thermal, chemical, physical and biological systems and processes used in the treatment of hazardous wastes and the remediation of hazardous waste sites. *(On demand)*

**CEGR 5235. Industrial Pollution Control. (3)** Prerequisite: permission of department. Source and characterization of industrial wastewaters. Fundamentals of chemical and physical treatment processes. Biological treatment technologies. Waste minimization and reduction technologies. Sludge handling and toxicity reduction. Implementation of field or laboratory treatability study. *(On demand)*

**CEGR 5237. Environmental Risk Management. (3)** Prerequisite: permission of department. Review of legislation and requirements pertaining to spills and releases of chemicals to the environment. Fundamentals of fires, explosions, toxic emissions and dispersion, hazardous spills, and other accidents. Study of techniques for accident prevention and spill control, and hazardous and risk assessment. *(On demand)*

**CEGR 5241. Chemical Processes in Water and Wastewater Treatment. (3)** Prerequisites: CHEM 1252, CEGR 3141, and permission of department. Chemical principles involved in the treatment of water and wastewaters; principles of chemical equilibrium relevant to natural water systems; the nature and effect of chemical interactions of domestic and industrial waste effluents on natural water systems. *(On demand)*

**CEGR 5242. Wastewater Treatment Plant Design. (3).** Prerequisites: Consent of the instructor, graduate student status. The course focuses on design of treatment processes for municipal wastewater treatment plants. It discusses the basics of physical, biological and chemical processes and their applications in wastewater treatment. *(On demand)*

**CEGR 5243. Topics in Environmental Health. (3)** Prerequisites: CEGR 3141, CEGR 4142, and permission of department. Study of contemporary environmental health problems and practices as they relate to groundwater pollution, food and water-borne diseases, radiological health, occupational health and risk assessment. Provides an introduction to epidemiology and toxicology, and a historical review of federal environmental policy and legislative action. *(On demand)*

**CEGR 5247. Sustainability. (3)** Prerequisite: CEGR 3141 and permission of department. The course will focus on sustainability as it applies to civil engineering, including land development choices, infrastructure planning, material selection and disposal, energy sources, and water supply and treatment. Methods of assessing sustainability and incorporating sustainable features in design will be reviewed. *(On demand)*

**CEGR 5262. Traffic Engineering. (3)** Prerequisites: CEGR 3161 and permission of department. Operation and management of street and highway systems. Traffic control systems, traffic flow theory, and highway capacity. Evaluation of traffic engineering alternatives and the conduct of traffic engineering studies. *(On demand)*

**CEGR 5264. Landfill Design and Site Remediation. (3)** Prerequisites: CEGR 3258, CEGR 3278, and permission of department. Principles of waste disposal and sanitary landfill siting including design, construction, operation and maintenance. Site assessment of underground

storage tank leaks; site remediation, and clean up technologies using choice and economic analysis and computer applications. (*On demand*)

**CEGR 5270. Earth Pressures and Retaining Structures. (3)** Prerequisites: CEGR 3122, CEGR 3278, CEGR 4278, and permission of the department. Corequisite: CEGR 4278 can be a corequisite. Lateral earth pressure theory and the effects of wall friction, external loads, groundwater, and layered soils; design procedures and construction details associated with selected rigid and modular gravity/semi-gravity walls, mechanically stabilized earth walls, and externally supported structural walls. (*On demand*)

**CEGR 5271. Pavement Design. (3)** Prerequisites: CEGR 3161, CEGR 3278, and permission of department. Pavement design concepts and considerations; engineering properties of pavement materials including soils, bases, asphalt concrete, and Portland cement concrete; design of flexible and rigid pavements including shoulders and drainage; computer applications for pavement analysis and design. (*On demand*)

**CEGR 5272. Design with Geosynthetics. (3)** Prerequisites: CEGR 3258, CEGR 3278, CEGR 4278, and permission of department. Corequisite: CEGR 4278 can be a corequisite. Introduction to geosynthetic materials, properties, laboratory test procedures, and functions; geosynthetic design methods used for geotechnical, transportation hydraulic, and geo-environmental applications (roadways, walls, slopes, foundation soils, landfills, and dams); the incorporation of geosynthetics for soil reinforcement, separation, filtration, drainage and containment. (*On demand*)

**CEGR 5273. Engineering Ground ImprovementSoil Improvement. (3)** Prerequisites: CEGR 3278 and permission of department. Engineering principles of soil improvement as they relate to applications in both geotechnical and geoenvironmental engineering; innovative techniques to improve soils to meet technical and economic requirements. (*On demand*)

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**CEGR 5274. Site Characterization. (3)** Prerequisites: CEGR 3278 and permission of department. Site investigation and site assessment technologies employed in geotechnical and environmental engineering; Site investigation planning and various geophysical methods including: seismic measurements, ground penetrating radar, electrical resistivity, and electromagnetic conductivity; Drilling methods for soil, gas and ground water sampling; decontamination procedures; and long term monitoring methods; Conventional and state-of-the-art in situ methods for geotechnical and environmental site characterization: standard penetration test, vane shear test, dilatometer test, pressure-meter test and cone penetration tests. Modern advances in cone penetrometer technology, instrumented with various sensors (capable of monitoring a wide range of physical and environmental parameters: load, pressure, sound, electrical resistivity, temperature, PH, oxidation reduction potential, chemical contaminants). (*On demand*)

**CEGR 5278. Geotechnical Engineering II. (3)** Prerequisites: CEGR 3258, CEGR 3278, and permission of department. Design of shallow and deep foundations, including structural considerations; lateral earth pressure theories; design of rigid and flexible earth retaining structures; advanced aspects of slope stability analysis; and computer applications. (*On demand*)

**CEGR 5892. Individualized Study and Projects. (1-6)** Prerequisite: permission of department. Individual investigation and exposition of results. *May be repeated for credit. (On demand)*

**CEGR 5991. Graduate Research in Civil Engineering. (1-6)** Prerequisite: permission of department. Independent study of a theoretical and/or experimental problem in a specialized area of civil engineering. *May be repeated for credit. (On demand)*

**CEGR 6090. Special Topics in Civil Engineering. (1-6)** Prerequisite: permission of department. Directed study of current topics of special interest. *May be repeated for credit. (On demand)*

**CEGR 6122. Advanced Topics in Structural Steel. (3)** Prerequisites: CEGR 4222 and permission of department. Theory of plastic-behavior of steel structures; current topics in structural steel. *(On demand)*

**CEGR 6124. Masonry Design. (3)** Prerequisites: CEGR 3225 and permission of department. Introduction of masonry materials and systems, engineering and materials properties and testing procedures. Design of reinforced and unreinforced masonry (clay and concrete) walls, beams, and columns for vertical, wind, and seismic loads. Analysis and design of masonry structures and introduction to computer applications. *(On demand)*

**CEGR 6125. Structural Strengthening. (3)** Prerequisites: CEGR 3221, CEGR 3225, and permission of department. Code requirements for the evaluation of existing structures; analysis of existing structures; performance based design of buildings and bridges; strengthening/retrofit techniques for concrete, structural steel, masonry and timber elements, such as beams, columns, shear/bearing/retaining walls, and slabs; studies of actual strengthening projects using innovative techniques and materials. *(On demand)*

**CEGR 6126. Analysis of Plates and Shells. (3)** Prerequisite: CEGR 4224 and permission of department. Analysis of rectangular and circular plates using classical as well as numerical methods; orthotropic and continuous plates and plate buckling. Analysis of thin shells and shells of revolution with and without bending; membrane theory of cylindrical shells; symmetric and unsymmetric loading; pipes, tanks, and pressure vessels; computer applications. *(On demand)*

**CEGR 6127. Fracture Mechanics and Fatigue. (3)** Prerequisites: CEGR 3221 and permission of department. Introduction to fracture mechanics and fatigue, including Griffith Theory, plane strain-stress conditions, critical stress intensity factors, factors influencing fracture toughness, fracture mechanics design principles, fatigue performance, and fatigue initiation and propagation. *(On demand)*

**CEGR 6128. Structural Optimization. (3)** Prerequisites: CEGR 4224 and permission of department. Introduction to optimization concepts; reformulation of common structural analysis and design problems to an optimization format; optimization of constrained, unconstrained, linear, and nonlinear problems by classical and numerical techniques; and computer applications. *(On demand)*

**CEGR 6129. Structural Dynamics. (3)** Prerequisites: CEGR 3122 and permission of department. Methods for dynamic analysis of single and multiple degree of freedom systems. Topics include: free vibrations, dynamic response of simple structures under time dependent loads (e.g., harmonic, periodic, impulsive, general dynamic loading), support motion, frequency domain analysis, response spectra, earthquake engineering. *(On demand)*

**CEGR 6141. Water Quality Modeling. (3)** Prerequisite: permission of department. Mathematical modeling of water quality in receiving streams including: generation of point and nonpoint sources of pollution; formulation of transport equations for contaminants in stream and estuarine water; and prediction of the fate, persistence and transformation of chemical pollutants in aquatic ecosystems. Computer model simulation and case studies. *(On demand)*

**CEGR 6142. Bioenvironmental Engineering. (3)** Prerequisites: CEGR 3141 and permission of department. Theoretical principles and design of aerobic and anaerobic biological unit processes for renovating waters and wastewaters. Activated sludge, aerated and facultative lagoons, rotating biological contractors, trickling and anaerobic filters. *(On demand)*

**CEGR 6144. Environmental Biotechnology. (3)** Prerequisite: permission of department. Application of biotechnology to the management of environmental problems. Study of bioprocess principles, bioremediation of waste disposal sites, cell immobilization technology and innovative biotechnologies. *(On demand)*

**CEGR 6145. Waste Incineration. (3)** Prerequisite: permission of department. Fundamentals of incineration of hazardous/solid wastes. Thermochemical applications and equipment design. Computer modeling of the incineration process and air quality control. *(On demand)*

**CEGR 6146. Advanced Groundwater Analysis. (3)** Prerequisite: permission of department. Modeling of groundwater flow in saturated and unsaturated zones. Contaminant transport including advection, dispersion and numerical modeling. Groundwater remediation technology. *(On demand)*

**CEGR 6147. Watershed Modeling. (3)** Prerequisite: Permission of department. Characterization of non-point source pollution; modeling of flow and pollutant transport in storm runoff. Watershed modeling in a GIS environment including applications of SWIMM, BASINS, HEC-HMS, HEC-RAS, and NRCS models. *(On demand)*

**CEGR 6148. Water Conservation. (3)** Prerequisite: permission of department. Principles and issues concerning water conservation and methods for effecting water conservation, including residential, industrial, commercial, and agricultural water conservation; water rates, audits and reuse/reclamation as they relate to water conservation; and case studies. *(On demand)*

**CEGR 6149. Watershed Analysis. (3)** Prerequisite: permission of department. Study of NPS problems in urban and non-urban watersheds and from highway runoff. Estimate of sediment yield and design of BMP's including sediment control structures. Introduction to monitoring and modeling of hydrologic systems. Watershed modeling in a GIS environment. *(On demand)*

**CEGR 6161. Traffic Control and Operation. (3)** Prerequisites: CEGR 5161 and permission of department. Traffic control theory and application; traffic regulation, laws and ordinances; speed control, intersection control, flow control and parking control; design and application of control devices, investigation, evaluation techniques; statistical analysis; administration. *(On demand)*

**CEGR 6162. Computer Applications for Transportation Engineers. (3)** Prerequisites: CEGR 3161 and permission of department. Apply analytical techniques using traffic simulation and transportation planning software to evaluate various transportation facilities; Emphasis on computer applications and software packages such as HCS, SYNCHRO/SimTraffic, and VISSIM; 4-Step planning process using TransCAD; Build mathematical models. *(On demand)*

**CEGR 6163. GIS for Civil Engineers. (3)** Prerequisites: CEGR 2101 and permission of department. Apply Geographic Information System (GIS) tools to solve Civil Engineering problems: add layers, label, and symbolize features, create maps in ArcMap, generate tables and spatial databases, address matching, query and join tables, perform spatial overlays, generate buffers, and conduct spatial analysis. Civil Engineering case studies. *(On demand)*

**CEGR 6164. Traffic Safety. (3)** Prerequisites: CEGR 3161 and permission of department. Crash data elements and source of data; Crash site reconstruction; Quantifying risk; Safety evaluation process: Problem definition, high crash locations, ranking and prioritization, understanding causal factors, countermeasure selection, before-after evaluation; Crash prediction Modeling; Economic appraisal; Safety conscious planning. *(On demand)*

**CEGR 6165. Urban Systems Engineering. (3)** Prerequisites: CEGR 3202 and permission of department. Survey of economic, political, sociological and technological factors affecting modern growth; a planning process and its role in solving selected urban problems with emphasis on engineering contributions. *(On demand)*

**CEGR 6166. Urban Transportation Networks: Operations & Optimization. (3).** Prerequisites: CEGR 3161 and permission of department, ~~Consent of the instructor~~, graduate student status. Introduction to planning and optimization techniques for the analysis of transportation networks; Principles of precise algorithms for finding transport network equilibrium flows and applications that relate to these flows; Topics include basic optimization skills, shortest path algorithms, user equilibrium, system optimal, elastic demand, OD matrix estimation, network design, congestion pricing, and stochastic user equilibrium. *(On demand)*

**CEGR 6167. Discrete Choice Modeling. (3).** Prerequisites: CEGR 3161 and permission of department, graduate student status. Introduction to elements of the choice process: utility-based choice theory; principles of binary choice models; multinomial logit models; nested logit models; and ordered response models. *(On demand)*

**CEGR 6171. Air Quality Control. (3)** Prerequisite: permission of department. Study of various types of air pollutants, their sources, nature and effects. Examination of air quality criteria, standards and monitoring. Analysis of feasibility, applicability and efficiency of diverse systems of control. Evaluation of goal and research needs in the future. *(On demand)*

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**CEGR 6172. Air Dispersion Modeling. (3)** Prerequisite: permission of department. Atmospheric pollution problems, federal regulations, boundary layer meteorology, dispersion theory, Gaussian model, plume rise formulas, air toxics, and computer modeling of point area, line and mobile sources. *(On demand)*

**CEGR 6173. Environmental Aquatic Chemistry. (3)** Prerequisites: CHEM 3111, CEGR 3141, or equivalent; and permission of department. Concepts of chemical equilibrium applied to natural aquatic systems. Topics include: acid-base reactions, buffer systems, mineral precipitation, coordinate chemistry, redox reactions, adsorption phenomena and chemical-equilibria computer programs. *(On demand)*

**CEGR 6181. Traffic Flow Theory. (3)** Prerequisites: CEGR 5161 and permission of department. Logical foundations and mathematical representation of traffic flow; interrelation between microscopic and macroscopic equations of motion for highway traffic; stochastic properties of traffic at low and moderate densities. Car-following theories of traffic flow at high densities. Applications of queuing theory. *(On demand)*

**CEGR 6182. Transportation Systems Analysis. (3)** Prerequisites: CEGR 5161 and permission of department. Issues, concepts and methods of transportation systems engineering and planning. Decision making in transportation management. The application of analytical methods to the development and evaluation of transport systems. *(On demand)*

**CEGR 6222. Experimental Structural Mechanics and Nondestructive Evaluation. (3).** Prerequisites: Consent of the instructor, graduate student status. This course presents a comprehensive overview of experimental techniques used to develop phenomenological understanding of and characterization of solid mechanics, stress analysis, and fracture mechanics problems. Additionally, the course presents experimental methods routinely employed for nondestructive evaluation of in-service structures, structural components, and structural materials. Students are expected to develop a familiarity with and ability to conduct data acquisition, signal processing, and data interpretation. *(On demand)*

**CEGR 6243. Physical Processes in Environmental Systems. (3)** Prerequisites: CEGR 3141, CEGR 3143, MATH 2171, and permission of department. Physical processes that describe the behavior of materials in natural and engineered environmental systems including transport, diffusion/dispersion, volatilization, sorption/desorption, flocculation, filtration, and sedimentation. *(On demand)*

**CEGR 6244. Chemical Fate and Transport. (3)** Prerequisites: CEGR 3141 and permission of department. Fate of chemicals in the environment and transport processes within and between phases; Environmental chemo-dynamics; Volatilization, dissolution and adsorption from an equilibrium perspective; Evaluation of mass transfer kinetics across environmental compartments. *(On demand)*

**CEGR 6245. Chemical and Biological Processes in Environmental Systems. (3)** Prerequisites: CHEM 1251, CEGR 3141, and permission of department. Chemical and biological processes that describe the behavior of materials in natural and engineered

environmental systems. Chemical processes to be covered may include acid-base reactions, equilibrium partitioning, pH buffering, precipitation/dissolution, complex formation, adsorption, oxidation-reduction, coagulation, and adsorption. Fundamentals of biological theories to be covered may include kinetics, bioenergetics, genetics, and cellular functions. *(On demand)*

**CEGR 6251. Foundation Engineering. (3)** Prerequisites: CEGR 3278 and permission of department. Methodologies for analysis and design of deep foundations including different construction layouts and configurations (e.g., single and group piles), different installation techniques (e.g., driven, drilled, ACIP, etc.), different loading conditions (e.g., axial compression, axial tension, lateral, general loading, etc), different design approaches (e.g., allowable stress design – ASD, and load and resistance factor design - LRFD), among other topics; New emerging technologies, construction and inspection aspects and their implications on deep foundation design, and other topics. *(On demand)*

**CEGR 6252. Soil Dynamics and Earthquake Engineering. (3)** Prerequisites: CEGR 3122, CEGR 3278, and permission of department. Review of the dynamics of single and multi-degree of freedom systems. Earthquake mechanism, distribution, magnitude, intensity, ground shaking, site effects, prediction, and response spectra. Soil liquefaction; aseismic design of foundations; seismic codes; and machine foundation design. *(On demand)*

**CEGR 6254. Experimental Soil Mechanics. (3)** Prerequisites: CEGR 3278 and permission of department. Experimental methods, with emphasis on laboratory tests, to determine engineering soil properties and investigate soil behavior; 1) classification tests (i.e., used to identify soil classification and identify general engineering behavior type); and 2) assessment of engineering properties, such as permeability, shear strength, stiffness, and compressibility. Primary lab tests to be covered in this course are: consolidation, direct shear, static tri-axial, cyclic tri-axial, cyclic simple shear, resonant column, and other advanced geotechnical laboratory tests. Also includes discussion on field sampling and testing, reconstituted samples, laboratory instrumentation, and measurement techniques. *(On demand)*

**CEGR 6255. Slope Stability and Earth Structures. (3)** Prerequisites: CEGR 3278 and permission of department. Soil and rock slope stability including the aspects of analysis, design, and stabilization within a geotechnical framework; Concepts related to seepage analysis of isotropic and anisotropic soil structures to relate the influence of groundwater conditions in slope stability problems; Presentation of slope stability analysis procedures based on limit equilibrium principles and stress-deformation analyses; Stability considerations of natural slopes and human-made soil structures. Computer software for seepage and slope stability analysis is explained. *(On demand)*

**CEGR 6261. Traffic Signal Control Systems. (3)** Prerequisites: CEGR 6161 and permission of department. Study of control systems for isolated intersections, arterial streets, closed networks, and freeways. Emphasis on computer models; state-of-the-art detection, control, and communications equipment and software; and intelligent vehicle/highway systems. *(On demand)*

**CEGR 6268. Advanced Soil Mechanics. (3)** Prerequisites: CEGR 3258, CEGR 3278, and permission of department. One and two-dimensional consolidation, layered strata effects, and

creep; seepage in layered strata, flow net, and seepage forces; shear strength parameters, effective and total stress paths, and application for slope stability evaluation; principles of critical state soil mechanics; computer applications. *(On demand)*

**CEGR 6891. Graduate Master Project. (3)** Prerequisite: permission of department. Individual investigation or exposition of results for the 3-hour Master project. (Fall, Spring, Summer)

**CEGR 6892. Individualized Study ~~and Projects.~~ (1-3)** Prerequisite: permission of department. Individual investigation or exposition of results for the 3-hour ~~MS project~~ study. ~~May be repeated for credit.~~ *(Fall, Spring, Summer)*

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**CEGR 6990. Industrial Internship. (1-3)** Prerequisite: Completion of nine hours of graduate coursework. Full- or part-time academic year internship in engineering complementary to the major course of studies and designed to allow theoretical and course-based practical learning to be applied in a supervised industrial experience. Each student's program must be approved by their graduate program director and requires a mid-term report and final report to be graded by the supervising faculty. *Graded on a Pass/Unsatisfactory basis.* Credit hours gained from Internship shall not be part of the minimum credit hours requirement for graduation. *(On demand)*

**CEGR 6991. Graduate Master Thesis ~~Research.~~ (1-6)** Prerequisite: permission of department. Individual investigation culminating in the preparation and presentation of a thesis. *May be repeated for credit. (Fall, Spring, Summer)*

**CEGR 6999. Graduate Master Additional Work. (1-3)** Prerequisite: permission of department. Each student will initiate or continue an individual investigation culminating in the preparation and presentation of a deliverable (could be part of Master Thesis or Project), upon meeting the 30-credit hours degree requirement. Graded on a Pass/Unsatisfactory or IP basis. May be repeated for credits. (Fall, Spring, Summer)

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**CEGR 8090. Special Topics.** Directed study of current topics of special interest. *(See the Infrastructure and Environmental Systems heading for details.)*

# APPENDIX C.



J. Murrey Atkins Library

## Consultation on Library Holdings

To: Dr. Srinivas Pulugurtha  
From: Jeff McAdams  
Date: 11/06/15  
Subject: CEGR 6167 – Discrete Choice Modeling

### Summary of Librarian's Evaluation of Holdings:

Evaluator: Jeff McAdams Date: 11/06/15

#### Check One:

- 1. Holdings are superior \_\_\_\_\_
- 2. Holdings are adequate   x
- 3. Holdings are adequate only if Dept. purchases additional items. \_\_\_\_\_
- 4. Holdings are inadequate \_\_\_\_\_

#### Comments:

Library holdings should be adequate to support student research for this course (see list of items held by subject heading below). Students will have access to relevant databases including *Compendex*, *Inspec*, *Science Direct*, *Web of Science*, *IEEE Xplore*, *ASTM Digital Library*, *CRC Engineering Handbooks*, and many others.

LC Subject Heading	Books	Journals
Econometrics	425	29
Decision making – mathematical models	288	3
Choice of transportation – mathematical models	34	0

  
\_\_\_\_\_  
Evaluator's Signature

11/06/15  
\_\_\_\_\_  
Date