

# 2013-2014 LONG SIGNATURE SHEET



**UNC CHARLOTTE**

Proposal Number: CEE 20131114

Proposal Title: Establishment of Permanent Course #s for CEE Graduate Courses and Associated Changes to the Graduate Catalog

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
11/18/13	11/19/13	11/19/13	Approved	<u>DEPARTMENT CHAIR</u>  John Daniels
11/19/13	11/19/13	11/19/13	Approved	<u>COLLEGE CURRICULUM COMMITTEE CHAIR</u>  Edward Morse
			Approved	<u>COLLEGE FACULTY CHAIR (if applicable)</u>  Arindam Mukherjee
	11/25/13	11/25/13	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)
11/24/13	12/3/13	17 Jan 2014	Approved	<u>GRADUATE COUNCIL CHAIR</u> (for graduate courses only)  Alan R. Freitag
				<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: November 13, 2013

Re: Proposal for New Graduate Courses (Permanent Numbers) and associated changes to CEE portion in the Graduate Catalog

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

#### **SUMMARY.**

- 1) The CEE Department proposes to add the following courses to its graduate curriculum leading to the MSCE and MSE degrees.

CEGR 5125 Forensic Engineering  
CEGR 5126 Codes, Loads, & Nodes  
CEGR 5127 Green Building & Integrative Design  
CEGR 5223 Timber Design  
CEGR 5273 Soil Improvement  
CEGR 5274 Site Characterization  
CEGR 6125 Structural Strengthening  
CEGR 6162 Computer Applications for Transportation Engineers  
CEGR 6163 GIS for Civil Engineers  
CEGR 6164 Traffic Safety  
CEGR 6243 Physical Processes in Environmental Engineering  
CEGR 6245 Chemical & Biological Processes in Environmental Systems  
CEGR 6244 Chemical Fate and Transport  
CEGR 6251 Analysis and Design of Deep Foundations  
CEGR 6253 Design of Waste Containment Systems  
CEGR 6254 Experimental Soil Mechanics  
CEGR 6255 Slope Stability and Earth Structures

Revised 07/31/13  
OAA/mjw

The aforementioned courses have been taught several times as “topics” courses (CEGR 5090 or CEGR 6090). Copies of syllabus for each course listed above are shown in Appendix A (in the same order).

The proposed courses have been well-received by students and well-regarded by the faculty. Verbal feedback received from practitioners (both public and private sector) who hired our students indicated that the concepts and topics learned from these courses had our students well-prepared to better solve real-world engineering problems.

A review by the CEE Curriculum Committee resulted in a strong recommendation that these courses be offered as a permanent elective in the graduate curriculum, and the CEE faculty agreed. Therefore, a permanent course number and a permanent catalog description are requested.

The course numbers were identified maintaining consistency with CEE past practices and recommended guidelines.

2) In addition to including descriptions of the proposed courses in the Graduate Catalog, appropriate information was also added to the core courses listed in the catalog. Based on discussions amongst faculty of respective concentrations, some other changes (addition or deletion) are proposed to the core courses listing. These changes to the CEE portion of the Graduate Catalog are highlighted (with track changes) in Appendix B.

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

The CEE department hired eleven new tenure-track faculty during the last eight years, while five faculty retired or relocated to other universities. The new faculty added breadth and depth to the expertise of the department. They offered several new courses to introduce our students to the state-of-the-art civil engineering topics and prepare them for their future.

The listed courses were taught several times during the past few years by the new faculty (as well as others who were part of CEE since prior to 2005). The courses and discussions provided ample opportunities for CEE graduate students to explore advanced / state-of-the-art concepts and, therefore, became an integral part of CEE graduate curriculum.

These courses are, often, listed on student transcripts as “special topic” without adequate detail. With multiple such courses in each concentration, most graduate students have two or more “special topics” listed on their transcripts. Since there is growing demand and need to offer these courses regularly, the best solution apparent to solve this problem is to have permanent course numbers and titles.

Further, several students benefitted by taking these courses and were hired by employers working in the subject areas. These courses also laid the foundation, exposed the students to techniques, and assisted them in conducting quality thesis and MS projects. A significant number of these efforts led to peer-reviewed publications and presentations at International, national, regional, and local conferences. Employers who hired our graduate students were not only happy

but lauded our efforts at introducing the state-of-the-art concepts. Overall, this led to strong recommendation by CEE faculty to offer these courses as a permanent elective for our graduate students.

### **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 courses are eligible to register. These students are expected to have adequate fundamentals, concepts, and credentials to enroll and successfully complete the aforementioned courses.

The listed courses are at 5000- and 6000-level, which is consistent with the level of academic advancement of students for whom the courses are intended. The proposal or proposed courses does not have any effect on degree completion requirements.

It is anticipated that 10 to 20 graduate students may take the proposed courses when offered. While some proposed courses will be offered every year (either during fall or spring), others will be offered during alternate years or based on demand. These details are provided in the enclosed graduate syllabus for each proposed course (Appendix A). If the demand increases, the proposed courses may be offered more frequently.

As stated previously, several of these courses were offered multiple times during the past several years. Since they have been an integral part of CEE graduate curriculum as “topics” courses, the proposed courses are not expected to have an effect on other courses offered regularly by the faculty of CEE department. In fact, they nicely complement and strengthen the program.

The addition of the proposed courses will have an effect on information in the CEE portion of the Graduate Catalog. The assigned numbers are added to the core courses listed by concentration. Descriptions, as required, are also added for each proposed course. The recommended changes to the Graduate Catalog are shown in Appendix B.

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

#### **A. PERSONNEL.**

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

CEGR 5125 Forensic Engineering (David Young)  
CEGR 5126 Codes, Loads, & Nodes (Janos Gergely)  
CEGR 5127 Green Building & Integrative Design (Brett Tempest)  
CEGR 5223 Timber Design (David Weggel)  
CEGR 5273 Soil Improvement (John Daniels / Vincent Ogunro)  
CEGR 5274 Site Characterization (Vincent Ogunro)  
CEGR 6125 Structural Strengthening (Janos Gergely)  
CEGR 6162 Computer Applications for Transportation Engineers (Srinivas Pulugurtha)  
CEGR 6163 GIS for Civil Engineers (Srinivas Pulugurtha)  
CEGR 6164 Traffic Safety (Srinivas Pulugurtha)

CEGR 6243 Physical Processes in Environmental Engineering (James Bowen)  
CEGR 6244 Chemical Fate and Transport (John Daniels)  
CEGR 6245 Chemical & Biological Processes in Environmental Systems (J. Amburgey)  
CEGR 6251 Analysis and Design of Deep Foundations (Miguel Pando)  
CEGR 6253 Design of Waste Containment Systems (Hillary Inyang)  
CEGR 6254 Experimental Soil Mechanics (Miguel Pando)  
CEGR 6255 Slope Stability and Earth Structures (Miguel Pando)

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

- B. **PHYSICAL FACILITY.** CEE has adequate space available to teach the aforementioned courses.
- 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 some of the listed courses. 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 (Alison Bradley) is attached for each proposed course (Appendix C).

Adequate resources are available for all courses, except “CEGR 6144: Chemical Fate and Transport.” While access of materials through interlibrary loan will be sufficient, the department commits to work with the library and purchase additional items. A letter from CEE Department Chair, related to the same, is enclosed in Appendix D.

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

Consultation with other departments or units was not necessary as the proposed courses were offered in the past, widely 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 courses contained in this proposal were initiated during the 2011-2012 academic year. The proposed courses were reviewed by the respective FAIT teams at meetings held during spring and fall 2012. A draft short-form proposal was prepared, reviewed and approved by the Department during spring 2013 for each course. As needed, this was followed by preparation of long-form proposal during fall 2013.

**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 a credit hour.

**C. ATTACHMENTS.**

**1. CONSULTATION:**

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

**2. COURSE OUTLINE/SYLLABUS:**

Syllabus with necessary details, as required for graduate courses, is provided for each 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 “~~striketrough~~” 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.

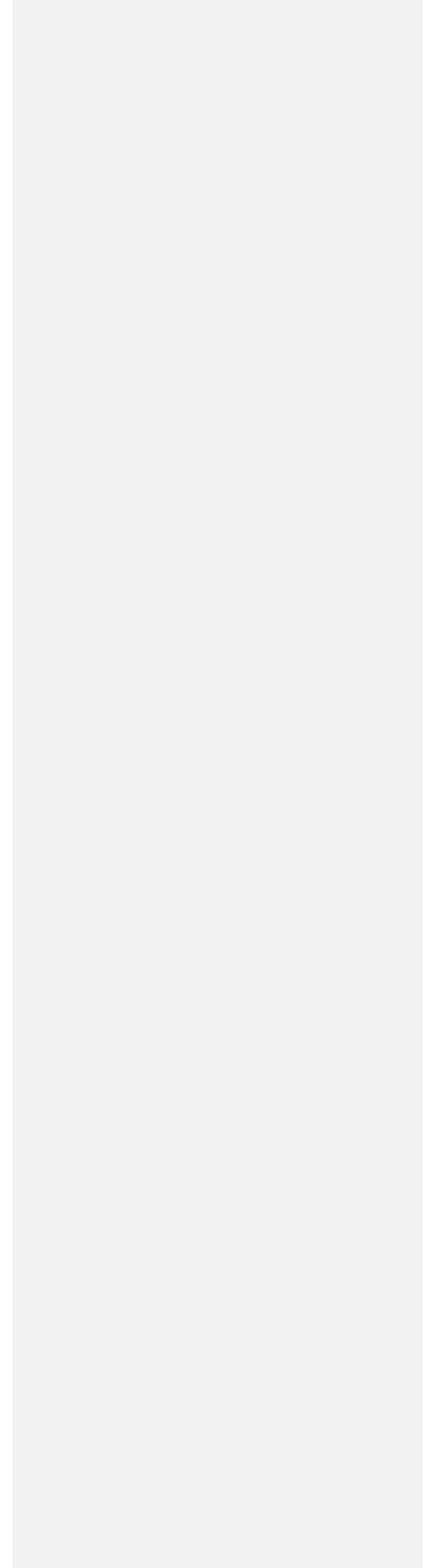
For all items checked above, applicable statements and content must be reflected in the proposed catalog copy.

- 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.
  - X 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?
- X Yes. Considered where appropriate.
  - No.

## **APPENDIX A.**





## **CEGR 5125 Forensic Engineering**

**Proposed and to be taught by:**

**Dr. David T. Young, Professor of Civil & Environmental Engineering**

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

**CEGR 5125. Forensic Engineering. (3). Prerequisite: CEGR 3122 – Structural Analysis I, or consent of the instructor, graduate student status.** 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. (*Fall, alternate years*)

### **Course Objectives**

- 1) Students will understand, through case studies, the types and causes of structural failures and relevant methods of failure investigation
- 2) Students will understand the impact of engineering opinions on legal proceedings

**# Credit Hours:** 3

**Frequency:** Offered every fall semester

**Instruction Method:** Lecture

### **Course Outcomes**

- 1) Students will be able to investigate, analyze, and draw conclusions regarding structural failures occurring in a variety of structures, involving a variety of materials, and resulting from a variety of causes.
- 2) Students will be able to express and defend their opinions orally and in writing with an understanding of the impact of their opinion on the legal process surrounding a failure claim.

### **Textbook:**

Forensic Engineering Investigations by Randall K. Noon (2001, CRC Press)

### **Expectation:**

Students will gain an understanding of structural theories governing failures as well as a systemic perspective of failures. Proof of these accomplishments will come through homework assignments, projects, quizzes, and exams.

**Grading:**

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

Grading scale for this course is different from CEGR 4125. Submissions (includes reports and presentations) are expected to be more professional and advanced from the graduate students. In addition, graduate students will be working on additional assignment and/or exam questions.

Grade will be estimated from the following:

Homework	10%	Projects	20%
Quizzes	35%	Final Exam	35%
TOTAL	100%		

**Homework:**

- 1) Unless otherwise noted on "Course Outline", homework will be due on Wednesday at the beginning of class, one week after it is assigned.
- 2) Homework will be collected, graded, and returned within one week. Late homework will not be accepted.

**General:**

- No makeup exams will be given without a written excuse or notification to the professor before the exam. No extra credit assignments will be made. Concerns about quiz grading should be expressed in writing and turned in with the quiz for review by the professor.
- Students are encouraged to discuss their homework with colleagues in the class. However, work turned in for credit must be an individual's own work.
- The UNC Charlotte Code of Student Academic Integrity will be enforced.

**Course Outline**

Week	Topics	Failure Case Studies (CS)	Reference	Assignments
1	Introduction; Classifications of Failures	Numerous examples	Chapter 1 + handouts	HW #1 assigned
2	Conducting an Investigation - process and style	Numerous examples	Chapter 1 + handouts	HW #1 due HW #2 assigned
3	Construction-related Failures; Preparing a Forensics Proposal	CS #1 = Timber and masonry church in Huntersville, NC	Chapter 1 + handouts	HW #2 due HW #3 assigned Proj. No. 1 assigned
4	Failures in Historic Structures	CS #2 = Timber, masonry, limestone church in Charleston, SC	Chapter 22 + handouts	HW #3 due HW #4 assigned
5	Failures Due to Wind	CS #3 = Hotel steel roof structure in Boone, NC	Chapter 2 + handouts	HW #4 due HW #5 assigned
6	Failures Due to Tornados, Hurricanes,	CS #4 = Timber and masonry apartment complex	Chapter 22 +	HW #5 due HW #6 assigned

	& Natural Disasters	in Raleigh, NC	handouts	Project #1 due
7	<b>Midterm Exam on Lectures No. 1 - 5</b>	-----	-----	-----
8	Failures in Stone and Steel Structures Non-Destructive Testing Preparing a Forensics Report	CS #5 = High-rise steel and limestone office building in Charlotte, NC	handouts	HW #6 due HW #7 assigned
9	Failures in Concrete Structures	CS #6 = Reinforced concrete water treatment facility in Albemarle, NC	handouts	HW #7 due HW #8 assigned Proj. No. 2 assigned
10	Responsibilities of a Forensic Engineer Failures Due to Vibrations	CS #7 = Medium-rise steel building, Charlotte, NC	handouts	HW #8 due HW #9 assigned
11	Failures Related to Safety	CS #8 = Traditional scaffolding collapse CS #9 = Crane boom collapse	Chapter 4 + handouts	HW #9 due HW #10 assigned Proj. No. 3 assigned
12	Failures Due to Blast, Explosion	CS #10 = Historic church, Charlotte, NC CS #11 = Historic residence, Concord, NC	Chapters 4, 9,10 + handouts	HW #10 due HW #11 assigned Project No. 2 due
13	Failures Due to Fire Statistical Sampling for Testing	CS #12 = Heavy timber restaurant in Chlt, NC CS #13 = Concrete/masonry dormitory in Chlt, NC CS #14 = Steel-frame warehouse, Harrisburg, NC	Chapters 7, 11 + handouts	HW #11 due HW #12 assigned
15	Forensics = Legal Aspects of Failure Investigations	Case Studies (CS) # 1, 3, 6	Chapter 1 + handouts	HW #12 due HW #13 assigned
16	Forensics = Legal Aspects of Failure Investigations	Case Studies (CS) # 8, 9, 12	Chapter 1 + handouts	HW #13 due HW #14 assigned Project No. 3 due
17	<b>Final Exam Comprehensive</b>	-----	-----	Note: HW #14 will not be collected

## CEGR 5126 Codes, Loads, & Nodes

### Proposed and to be taught by:

Dr. Janos Gergely, Associate Professor of Civil & Environmental Engineering

### Graduate Catalog – Information and Description

**CEGR 5126. Codes, Loads, and Nodes. (3). Prerequisite: CEGR 3122 – Structural Analysis I, with a grade C or better, graduate student status.** 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. (Fall)

**# Credit Hours:** 3

**Frequency:** Offered every fall semester

**Instruction Method:** Lecture

**Text:** handouts

### Mandatory Code (will be purchased through ASCE):

- “*Minimum Design Loads for Buildings and Other Structures – ASCE7-10*”, American Society of Civil Engineers (ASCE), 2010.

### Other helpful Publications

- “*2006 North Carolina State Building Code*”, ICC, 2006.
- “*International Building Code – IBC2006*”, International Code Council, 2006.
- N. Taly, “*Loads and Load Paths in Buildings – Principles of Structural Design*”, International Code Council (ICC), 1<sup>st</sup> Edition, 2003.
- K.C. Mehta, and J.M. Delahay, “*Guide to the Use of the Wind Load Provisions of ASCE7-02*”, ASCE, 2004.
- A. Williams, “*Seismic and Wind Forces – Structural Design Examples*”, ICC, 3<sup>rd</sup> Edition, 2007.

**Prerequisites:** CEGR 3122 – Structural Analysis I, with a grade C or better, graduate student status.

### Course Objectives

The course will provide information on standard codes pertaining to building loads, including dead, live, roof, snow loads, wind and seismic forces. The students will also have an opportunity to use the latest SAP2000 software (available to engineering students on the MOSAIC network) to analyze realistic 2-D and 3-D buildings, using the above mentioned loads and code required load combinations.

The class will be focused primarily on building loads, but many of its applications are transferable to the bridges and other structures, and to the geotechnical field (after all, something has to hold up all those structures...). As such, the knowledge of the topics covered in this class will be essential in upper (undergraduate and undergraduate) level structural design courses, as well as in the successful completion of senior design projects with a structural emphasis.

### **Student Conduct**

Students have the responsibility to know and observe the requirements of The UNCC Code of Student Academic Integrity (latest revision). This code forbids cheating, fabrication, or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty. Students who violate the code can be expelled from UNCC. The normal penalty for a first offense is zero credit on the work involving dishonesty and further substantial reduction of the course grade.

In almost all cases, the course grade is reduced by a letter grade – at a minimum. Copies of the code can be obtained from the Dean of Student Office. CE Department policy is that ALL instances of suspected cheating be handled according to The UNCC Code of Student Academic Integrity (latest revision). *During this class, each student will be required to work independently, and submit their own solution for each assignment, unless the assignment specifies a team project. No teamwork or copying will be allowed.*

### **Homework Assignments**

New assignments will be given at the beginning of the class. Unless otherwise specified, each problem will be solved using calculators (not computers). Homework problems are due at the start of the class on the due date! Each problem will contain: problem number, a complete statement (figures, etc.) of the given and the required, and a complete solution. **The answer will be clearly indicated, including all the necessary calculations and drawings.** Problems not submitted on time and in proper format will not be accepted without an acceptable excuse. Copying the homework is not allowed, anyone so doing, or so allowing, will be charged according to the Academic Code.

### **Midterm and Exam Schedule**

Students are expected to attend class regularly and punctually, failure to do so will result in a lower class grade. A grade zero will be given any student who misses an exam unless a valid excuse is presented promptly in writing. Any absence that is predictable should be discussed with the course instructor in advance. **Check the exam schedules to see if you have a valid exam conflict.** You must notify me via an appropriate form of any such conflict involving this class by the end of Drop-Add.

### **Grading**

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

Grading scale for this course is different from CEGR 4126. Submissions (includes reports and presentations) are expected to be more professional and advanced from the graduate students. In addition, graduate students will be working on additional assignment and/or exam questions.

Grade will be estimated from the following:

Homeworks.....	25%
Quizzes.....	10%
Midterm.....	30%
Final .....	35%

### **Additional Course Requirements**

- Your written work must be *neatly presented* and easily followed.
- *Dimensioning* should use standard engineering graphics procedures.
- *Units* are very important – show units on all intermediate answers as well as on the final answer.
- When a textbook or design code is utilized to obtain any data, the page number, table number, and/or equation number must be appropriately *referenced*.
- Computer applications will be used throughout the semester to illustrate different load paths in buildings, make sure you have a MOSAIC account with available disk space. However, unauthorized PC and phone use during the class will not be permitted!

### **Course Outline**

Introduction

Building Systems and Components

Structural Codes

Building Loads

- Gravity Loads (dead, live, roof live)
- Snow Loads
- Wind Forces
- Seismic Forces

Load Combinations

Load Paths in Buildings

Computer Applications

- 2-D Analyses
- 3-D Analyses

## **CEGR 5127 Green Building and Integrative Design**

**Proposed and to be taught by:**

**Dr. Brett Tempest, Assistant Professor of Civil & Environmental Engineering**

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

**CEGR 5127. Green Building and Integrative Design. (3). Prerequisite: CEGR 3122 – Structural Analysis I, or consent of the instructor, graduate student status.** Course topics prepare 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*)

**# Credit Hours: 3**

**Frequency:** On demand

**Instruction Method:** Lecture

### **Course Objectives**

Course topics prepare 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 strategies for integrated design. Students will develop familiarity with the issues associated with green building, current standards, and the state of the art in available design strategies and technologies available to engineers.

**Prerequisites:** CEGR 3122 – Structural Analysis I, or consent of the instructor, graduate student status.

### **Student Conduct**

Students are responsible to read and adhere to the requirements of *the UNC Charlotte Code of Student Academic Integrity* (latest revision). This code forbids cheating, fabrication or falsification of information, multiple submissions of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty. Students who violate the code can be expelled from UNC Charlotte. The normal penalty for a first offense is zero credit on the work involving dishonesty and a further substantial reduction of the course grade. In almost all cases, the course grade is reduced to an “F”. Copies of the code can be obtained from the Dean of Student Office. The Civil Engineering Department policy is that ALL instances of suspected cheating be handled according to *the UNC Charlotte Code of Student Academic Integrity* (latest revision).

**Grading**

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

Grading scale for this course is different from CEGR 4127. Submissions (includes reports and presentations) are expected to be more professional and advanced from the graduate students. In addition, graduate students will be working on additional assignment and/or exam questions.

Grade will be estimated from the following:

Midterm	10%
Final Exam	15%
Homework	15%
Case Study Presentation	15%
Group Project	30%
Project Reviews (3)	10%
Participation & Attendance	5%

**Course Outlines**

- 1) Site Planning- Consideration of topography, vegetation, solar access and surroundings to locate and orient buildings and other features.
- 2) Design Strategies- Integrated design, the charrette, energy and solar modeling.
- 3) Structural Systems – Opportunities for structural components to do double-duty as pieces of the indoor environmental control system (chilled beam, radiant floor, etc); traditional design strategies to optimize weight and reduce the resource intensiveness of the structure.
- 4) Concrete Materials – Green concretes that incorporate wastes and recycled materials; reuse of building materials; recycled materials.
- 5) Building Energy Systems- Radiant Systems, embedded tubes, continuous insulation, ASHRE standards.
- 6) Detailing for Performance- layers of vapor barrier and insulation systems; eliminating thermal breaks through better structural layout planning; designing for deconstruction.
- 7) Rating Systems and Standards- LEED, NetZero, etc.
- 8) Case Study- Examples of civil engineering design in existing green buildings.



## CEGR 5223 Timber Design

### Proposed and to be taught by:

Dr. David Weggel, Associate Professor of Civil & Environmental Engineering

### Graduate Catalog – Information and Description

**CEGR 5223. Timber Design. (3). Prerequisite: CEGR 3122 – Structural Analysis I, or consent of the instructor, graduate student status.** 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. (Fall)

**# Credit Hours:** 3

**Frequency:** Offered every fall semester

**Instruction Method:** Lecture

**Prerequisites:** CEGR 3122 – Structural Analysis I, or consent of the instructor, graduate student status.

### Course Objectives

After successfully completing this class, students will be capable of designing simple timber structures subjected to gravity loads and lateral forces. Students will be able to compute design loads applied to the structure, formulate a structural system, and design/analyze structural components and connections so that individual structural components act together as a complete structural system.

### Textbook and Other Materials

Donald E. Breyer, Kenneth J. Fridley, Kelly E. Cobeen, and David G. Pollock, Jr., Design of Wood Structures – ASD/LRFD, 6<sup>th</sup> Edition, McGraw-Hill, 2007.

**Code:** National Design Specification for Wood Construction, Commentary, and Supplements, NDS 2005 Edition, AF&PA / AWC (order online)

Additional references will be mentioned in class as well as in the “Publications” and “References” sections of the textbook.

### Grading

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

Grading scale for this course is different from CEGR 4223. Submissions (includes reports and presentations) are expected to be more professional and advanced from the graduate students. In addition, graduate students will be working on additional assignment and/or exam questions.

Grade will be estimated from the following:

Homework	10%	(see Note 1 below)
Attendance/participation	5%	
Quizzes	15%	

Midterm	35%
Final Exam	35%

Note:

1. A homework grade of at least 70% is required to obtain a course grade of a C or better.
2. The standards and requirements set forth in this syllabus may be modified at any time by the course instructor. Notice of such changes will be by announcement in class.

### Homework

Unless otherwise noted, homework will be due at the beginning of class one week after it was assigned. Late homework will not be accepted. Unless otherwise noted, homework is to be solved using “calculators”, not computers. Each problem should be numbered, include a problem statement, follow a clear concise solution methodology, and reference all sources of data. The final answer(s) for each problem must be clearly identified. A portion of the homework problems will be graded at random; each student’s overall homework grade will be based on the results of these graded problems. However, solutions will be provided for all assigned problems after the homework has been submitted.

### Important course Policies

#### *Classroom Expectations*

This syllabus contains the policies and expectations I have established for CEGR 5090/CEGR 4223: Timber Design. Please read the entire syllabus carefully before continuing in this course. These policies and expectations are intended to create a productive learning atmosphere for all students. Unless you are prepared to abide by these policies and expectations, you risk losing the opportunity to participate further in the course.

#### *Classroom Environment*

I will conduct this class in an atmosphere of mutual respect. I encourage your active participation in class discussions. Each of us may have strongly differing opinions on the various topics of class discussions. The conflict of ideas is encouraged and welcome. The orderly questioning of the ideas of others, including mine, is similarly welcome. However, I will exercise my responsibility to manage the discussions so that ideas and argument can proceed in an orderly fashion. You should expect that if your conduct during class discussions seriously disrupts the atmosphere of mutual respect I expect in this class, you will not be permitted to participate further.

#### **Minimum Time Expectations for this 3-Credit Course**

This 3-credit course requires 3 hours of direct faculty classroom instruction and a *minimum* of 6 hours of out-of-class student work each week for approximately 15 weeks. Out-of-class work may include but is not limited to: required reading, library and online research, written assignments, and studying for quizzes and exams. Budget enough hours per week for this course accordingly.

#### *Academic Integrity*

All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online (<http://legal.uncc.edu/policies/up-407>).

#### *About Cell Phones and Smart Phones*

The use of cell phones, smart phones, or other mobile communication devices is disruptive, and is therefore prohibited during class. Except in emergencies, those using such devices must leave the classroom for the remainder of the class period.

### **Additional Course Guidelines**

- All written work must be neat and organized so that it can be easily graded.
- Dimensioning should follow standard engineering graphical procedures.
- When a textbook, design code, or other reference is used to obtain pertinent data, the page number, table number, and/or equation number must be appropriately referenced.
- All quantities should be associated with the appropriate units; include units with intermediate and final answers.
- All course materials (notes, handouts, homework, quizzes, and exams) must be kept in a single notebook for “Timber Design”; this is a requirement to help us maintain ABET accreditation.
- No extra credit assignments will be given.
- No makeup exams (quizzes) will be given without *proper* notification *before* the exam (quiz).
- Failure to attend class may result in a lower course grade.
- *Work external to the university will never be an excuse for failure to: turn in any assignment on time, take any in-class quiz or exam, or attend class.*

### **Course Outline**

1. Review
2. Introduction
3. Vertical loads
4. Lateral forces (Wind/Seismic)
5. Behavior of Structures
6. Properties of Wood
7. Modification Factors
8. Glulam
9. Beam Design
10. Axial Members (Pure Tension, Tension and Bending)
11. Axial Members: Column Design (Pure Compression)
12. Column Design (Axial Load and Bending, Eccentricities)
13. Plywood and Wood Structural Panels
14. Diaphragms
15. Shearwalls
16. Connections

## **CEGR 5273 Soil Improvement**

**Proposed and to be taught by:**

**Dr. Vincent Ogunro, Associate Professor of Civil & Environmental Engineering**

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

**CEGR 5273. Soil Improvement. (3). Prerequisites: CEGR 3278 - Geotechnical Engineering I or consent of the instructor, graduate student status.** 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. (*Spring*)

**# Credit Hours:** 3

**Frequency:** Offered every spring semester

**Prerequisites:** CEGR 3278 - Geotechnical Engineering I or consent of the instructor, graduate student status.

### **Course Objectives**

The objectives of this course are to review soil properties and the need for soil improvement, densification of soils through deep and shallow compaction; vibrocompaction, vibroreplacement, dewatering through consolidation, drainage, pumping and electrokinetics; modification through heating and freezing techniques; reinforcement with geosynthetics; grouting, stabilization with additives including industrial by-products and waste materials.

### **Expected Outcomes**

After completion of this course, students should be able to specify and apply techniques to improve soils that are otherwise unsuitable for use in geotechnical and geoenvironmental applications.

**Instruction Method:** Lecture

This semester-long course is divided into three modules. The course will progress in sequence, and students are required to make a B or better in each module to pass the course.

<b>Module Number and Name</b>	<b>Dates</b>
Module 1: Geotechnical Engineering Review	
Module 2: Physical Methods	
Module 3: Chemical Methods	

### **Reference Texts**

Because of the multitude of sources of relevant information and the unique nature of this course, no single textbook is required. Notes and relevant material will be provided and the following texts may serve as reference material.

- “Engineering Principles of Ground Modification” Hausmann, M.R. 1990, McGraw-Hill.
- “Ground Control and Improvement” Xanthakos, P.P., Abramson, L.W. and Bruce, D.A. 1994, John Wiley and Sons.
- “Foundation Engineering Handbook” Fang, H-Y. Editor, 1991 Van Nostrand Reinhold.

### **Grading**

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

Grading scale for this course is different from CEGR 4273. Submissions (includes reports and presentations) are expected to be more professional and advanced from the graduate students. In addition, graduate students will be working on additional assignment and/or exam questions.

Grade will be estimated from the following:

Exam 1:	20%
Exam 2:	20%
Exam 3:	20%
Term paper:	15%
Homework:	25%

### **Course Outline**

#### **Module 1: Geotechnical Engineering Review**

*Lecture 1:* Introduction, soil improvement applications, difficult soils, site investigation

*Lecture 2:* Flow through soils, well drawdown, effective and total stress, surcharge

*Lecture 3:* Shear strength in sands, clays.

*Lecture 4:* Bearing capacity and consolidation

*Lecture 5:* Slope stability and earth pressure

*EXAM 1*

#### **Module 2: Physical Methods**

*Lecture 6:* Preloading, vertical drains, pumping

*Lecture 7:* Vibrofloatation, vibroreplacement

*Lecture 8:* Blasting, dynamic compaction

*Lecture 9:* Freezing, heating

*Lecture 10:* Geosynthetics

*EXAM 2*

#### **Module 3: Chemical Methods**

*Lecture 11:* Grouting

*Lecture 12:* Deep soil mixing

*Lecture 13:* Electrokinetics

*Lecture 14:* Admixtures, lime, Utilization of waste materials

*EXAM 3*

## CEGR 5274 Site Characterization

**Proposed and to be taught by:**

**Dr. Vincent Ogunro, Associate Professor of Civil & Environmental Engineering**

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

**CEGR 5274. Site Characterization. (3). Prerequisites: CEGR 3278 - Geotechnical Engineering I or consent of the instructor, graduate student status.** 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, pressuremeter 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). *(Fall)*

**# Credit Hours:** 3

**Frequency:** Offered every fall semester

**Prerequisites:** CEGR 3278 - Geotechnical Engineering I or consent of the instructor, graduate student status.

### **Course Objectives**

This course is designed to give students a good understanding of the various aspects of site investigation/characterization technologies employed in geotechnical and environmental engineering projects. The importance of planning, design and monitoring as well as the variability and uncertainties in geologic materials and formation are emphasized.

### **Reference Books**

Because of the unique nature of this course, no single textbook is required. These are some of the reference books for this course. Additional list of books, papers and reports will be provided during the course.

- Annual Book of ASTM Standards (1998), Volume 04.08 Soil and Rock; Building stones, American Society for Testing and Materials.
- "Cone Penetration Testing in Geotechnical Practice" by T. Lunne, P. K. Robertson and J. J. M. Powell, Published by Blackie Academic and Professional, an imprint of Chapman & Hall, 1997.
- "The Pressuremeter" by Jean-Louis Briaud, Published by A. A. Balkema, 1992.
- "Geotechnical Site Characterization" Proceedings of the First International Site Characterization Conference, Atlanta, GA, (eds. Robertson, P. K. and Mayne, P. W.), A.A. Balkema, Rotterdam, 1998.

- "Proceedings of the International Symposium on Cone Penetration Testing", Linkoping Sweden, Published by the Swedish Geotechnical Society, 1995.
- "Environmental and Engineering Geophysics" by Prem V. Sharma, Published by Cambridge University Press, 1997.
- "Basic Exploration Geophysics" by Robinson, E. S., and C. Coruh, John Wiley, 1988.
- "Applied Geophysics" by Telford, W. M., L. P. Geldart, and R. E. Sheriff,, 2nd ed., Published by Cambridge University Press, 1990.

**Instructional Method:** Lecture

**Grading**

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

Grading scale for this course is different from CEGR 4274. Submissions (includes reports and presentations) are expected to be more professional and advanced from the graduate students. In addition, graduate students will be working on additional assignment and/or exam questions.

Grade will be estimated from the following:

Special Term Project	10%
Assignments	25%
Projects & Presentations	25%
Midterm Exam	20%
Final Exam	20%

**Attendance Requirement:** 100%

**Course Content**

WEEK	SUBJECT
1	Introduction, project initiation/planning, and sampling
2	Drilling, Sampling and Standard Penetration Test
3	Labor Day Holiday – no classes
4	Cone Penetration Test
5	Dilatometer and Pressuremeter Test
6	Vane Shear and Iowa Bore Hole Shear Tests (not before 6:30 PM)
7	Review of In-situ testing
8	Student Recess – no classes
9	Mid-term Exam
10	Groundwater monitoring and Permeability
11	Geophysical Methods I (Gravity, and Magnetic Methods)
12	Geophysical Methods II (Seismic, and Electrical Resistivity Methods)
13	Geophysical Methods III (Ground Penetrating Radar Methods)

14	Uncertainty in the Geologic Environment.
15	Exam 2
16	Reading day
17	Project presentation and submission

**General**

No extra credit assignments will be given under any circumstance.

No makeup exams will be given except when proper notification or excuse provided before the exam

Concern about quiz grading should be expressed in writing and turned in with the quiz for consideration.

Students are expected to familiarize themselves with and observe the requirements of the UNC Charlotte Code of Student Academic Integrity (latest version). The full code is available online at <http://www.uncc.edu/policystate/ps-105.html>



## **CEGR 6125 Structural Strengthening**

**Proposed and to be taught by:**

**Dr. Janos Gergely, Associate Professor of Civil & Environmental Engineering**

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

**CEGR 6125. Structural Strengthening. (3) Prerequisite: CEGR 3221 – Structural Steel Design I and CEGR 3225 – Reinforced Concrete Design I, with a grade C or better, graduate student status.** 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. (*Spring*)

**# Credit Hours:** 3

**Frequency:** Offered every spring semester

### **Prerequisites**

- CEGR 3225 - Reinforced Concrete Design I (and second course strongly recommended)
- CEGR 3221 - Structural Steel Design I (and second course strongly recommended)
- Would be beneficial to have some of these classes: masonry/bridge/timber design, FE, dynamics, NDE!

### **Course Objectives**

This graduate level class will provide information on the analysis of structures, and the design of strengthening/retrofit/repair techniques for concrete, structural steel, masonry and timber elements, such as beams, columns, shear/bearing/retaining walls, slabs, etc... Furthermore, this class will also provide, through special projects/case studies, experience with the detailed analysis of real structural systems (buildings and bridges), and the design of the strengthening/retrofit/repair measures required to bring the structures up to the required performance level.

### **Text**

- Handouts
- Design/structures textbooks

### **Codes**

- International Code Council, *International Building Code*, 2006 (or later editions)
- North Carolina Building Code Council, North Carolina Building Code, 2006
- ASCE 7-05, and other model codes

**Instruction Method:** Lecture

### **Student Conduct**

Students have the responsibility to know and observe the requirements of The UNCC Code of Student Academic Integrity (latest revision). This code forbids cheating, fabrication, or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty. Students who violate the code can be expelled from UNCC. The normal penalty for a first offense is zero credit on the work involving dishonesty and further substantial reduction of the course grade. In almost all cases, the course grade is reduced to "F". Copies of the code can be obtained from the Dean of Student Office. CE Department policy is that ALL instances of suspected cheating be handled according to The UNCC Code of Student Academic Integrity (latest revision).

### **Project Assignments**

Several project assignments will be given throughout the semester. Unless otherwise specified, each problem will be solved individually and using tools available to structural engineers.

### **Presentation Schedule**

Students are expected to attend class regularly and punctually; failure to do so, will result in a lower class grade. A grade zero will be given any student who misses a presentation or project report deadline, unless a valid excuse is presented promptly in writing. Any absence that is predictable should be discussed with the course instructor in advance.

### **Additional Course Requirements**

- Your written work must be **neatly presented** and easily followed.
- When a textbook or design code is utilized to obtain any data, the page number, table number, and/or equation number must be appropriately **referenced**.
- **Dimensioning** should use standard engineering graphics procedures. **Units** are very important – show units on all intermediate answers as well as the final answer.

### **Grading**

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

Grade will be estimated from the following:

Reports.....60%

Presentations.....40%

### **Course Outline**

- Introduction
- Building code requirements
- Building systems
- Bridge systems
- Seismic performance levels
- Structural assessment
- Beam strengthening techniques
- Column strengthening techniques
- Slab and wall strengthening techniques
- Advanced computational methods

## **CEGR 6162 Computer Applications for Transportation Engineers**

**Proposed and to be taught by:**

**Dr. Srinivas S. Pulugurtha, Associate Professor of Civil & Environmental Engineering**

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

**CEGR 6162. Computer Applications for Transportation Engineers. (3). Prerequisites: CEGR 3161 – Introduction to Transportation Engineering or consent of the instructor, graduate student status.** 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. (*Spring, alternate years*)

**# Credit Hours: 3**

**Frequency:** Offered alternate spring semester

### **Course Objectives**

The objectives of the course are to:

1. Educate students to better understand how to evaluate traffic facilities using appropriate method and simulation software,
2. Develop skill sets to address existing transportation problems by recognizing failure of a traffic facility, selecting suitable alternatives, and conducting economic analysis, and
3. Experience team-work in design, analysis, and presentation of project outcomes.

By the end of the course, students are expected to:

1. Have an understanding of features and capabilities of various transportation related software,
2. Have skills to analyze and address transportation engineering/planning problems using HCS, SYNCHRO/SimTraffic, VISSIM, and, TransCAD, and
3. Recognize the need and importance for continued learning of traffic simulation software throughout their career.

### **Reference Material**

1. Highway Capacity Manual - HCM (2000) Special Report 209, Transportation Research Board, Washington DC.
2. Trafficware. Synchro User Guide, Albany, NY, 2004.
3. PTV Vision. VISSIM User Guide.
4. Caliper. TransCAD User Guide, Caliper Corporation.

**Prerequisite:** CEGR 3161 – Introduction to Transportation Engineering or consent of the instructor, graduate student status

## Grading

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

Grade will be estimated from the following:

Biweekly Assignments/Mini-projects	40%	
Term Project	<u>60%</u>	(Written report and in-class oral presentation)
	<u>100%</u>	

**Instruction Method:** Lecture / Lab

## Course Outline

1. Introduction
2. Highway Capacity Software (HCS)
  - a. Basic freeway sections
  - b. Ramps, weaving sections
  - c. Highways and two-lane rural roads
  - d. Intersection (pre-timed and actuated)
3. CORSIM
  - a. Freeway sections
  - b. Intersections analysis and simulation
4. SYNCHRO/SimTraffic
  - a. Freeways
  - b. Intersection (signalized intersection, roundabout)
  - c. Small transportation network
5. VISSIM
  - a. Freeways
  - b. Intersection (signalized intersection, roundabout)
  - c. Small transportation network
  - d. Rail-road crossing (use of detectors; transit)
6. Trip generation software and 4-step planning process using TransCAD
7. Build mathematical models

## Class Attendance

Students are expected to attend all class meetings for the course. Any missed attendance should receive prior authorization from the instructor except under extenuating circumstances. It is the student's responsibility to obtain information pertaining to class discussions, announcements made, lecture notes or handouts distributed during any missed session(s) - please make arrangements with your classmates. Students with unauthorized absences from class meetings risk having their final score for the course dropped by 0.5 points for every unauthorized absence from class meetings.

Turn off all cellular phones, beepers, etc. that make audible sounds when in class. If you are expecting an EXTREMELY URGENT call or signal, please have the courtesy to discuss the same with the instructor and other students prior to the start of the class session and obtain the

instructor's permission to leave your communication device turned on for the duration of that class session.

Refrain from coming late, leaving in the middle of the class, walking in and out of the classroom during the class, or eating in the class since it tends to distract others in the room. If you have to eat for health reasons, do without disturbing others and clean up and dispose of any litter you may create while eating at the end of the class period and prior to leaving the class room. Students coming late to the class, leaving in the middle of the class or walking in and out of class meetings risk having their final score for the course dropped by 0.5 points for every such unauthorized instance.

### **Submission of written work**

Document all of your work (assignments, reports, data used for analysis, source of data used, etc.) as completely as possible. Your writing should be as professional in quality as possible. Each question (even if it is a "problem") must be accompanied by at least one sentence summarizing your findings. All pages of an assignment or submission must be stapled together, be in a legible and well-organized format. *All submissions must include the following information on the first page:*

*Name*

*Assignment number or report title*

*Date of submission*

*Time Spent in Hours*

It is better for you to submit whatever work you have completed at the time that the work is due and then submit work that you complete after this time as a late submission (rather than turning all the work as a late submission).

### **Honor Code**

*All students are expected to follow the honor code - submit only your original work! Students are expected to work individually on their assignments, unless otherwise instructed by the instructor in the assignment description. Students may discuss the assignment problems (interpretation of the questions, procedures to be used, etc.) in groups. Students may use such discussions to better understand the question or alternative methods of addressing the problem. However, the final submission **must** be the result of the student's individual effort.*

*Provide proper credit (citations) where appropriate (includes data that you did not collect but gathered from various sources and used in analysis).*

*The instructor reserves the right to request any information that was used in the analysis but was not documented in submitted assignments or reports.*

*Penalties for violating standards of academic integrity could be severe and are stated in the "UNC Charlotte Code of Student Academic Integrity".*

**Late Submission Policy**

The assignments will be due at the start of the lecture period on the dates specified when they are handed out or distributed electronically. In general, you will have at least 7 days to work on each assignment. Assignments submitted late will be accepted at the discretion of the instructor and would carry penalties (a minimum penalty of 10 percent for one day; penalty increases with the lateness of your submission). Late submissions will not be accepted after solutions have been posted or discussed in the class.

**Other UNC Charlotte Policies*****Disability***

If you have a disability that qualifies you for academic accommodations, provide a letter of accommodation from the Office of Disability Services at the beginning of the semester. The Office of Disability Services is located in Fretwell Building, Room # 230. The phone # is 704-687-4355 (Voice/TTY).

***Religious Holidays***

Any student missing class or lab work because of observance of religious holidays shall be given an opportunity during the semester to make up missed work. Please notify well in advance (at least a week) of anticipated absences to be assured of this opportunity.

***Absences due to Official UNC Charlotte Activity***

Students who represent UNC Charlotte at any official extracurricular activity shall have the opportunity to make up assignments, but the student must provide official written notification to the instructor no less than one week prior to missed class(es).

## **CEGR 6163 GIS for Civil Engineers**

### **Proposed and to be taught by:**

**Dr. Srinivas S. Pulugurtha, Associate Professor of Civil & Environmental Engineering**

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

**CEGR 6163. GIS for Civil Engineers. (3). Prerequisites: CEGR 2101 – Engineering Drawing, AutoCAD, or consent of the instructor, graduate student status.** Apply Geographic Information System (GIS) tools to solve Civil Engineering problems: add layers, label, & symbolize features, create maps in ArcMap, generate tables & spatial databases, address matching, query & join tables, perform spatial overlays, generate buffers, and conduct spatial analysis. Civil Engineering case studies. (*Fall, alternate years*)

**# Credit Hours: 3**

**Frequency:** Offered alternate fall semester

**Instruction Method:** Lecture / Lab

### **Course Objectives**

The objectives of the course are to:

1. Educate students to gain knowledge and use features available in a GIS software, and,
2. Have students develop skills to solve Civil Engineering problems using GIS.

By the end of the course, students are expected to:

1. Have an understanding of GIS and its capabilities, and
2. Have skills to solve Civil Engineering problems using commercial GIS software such as ArcMap.

### **Reference Text**

Ormsby, Tim, E. Napoleon, R. Burke, C. Groeff, and L. Feaster. (2004) *Getting to Know ArcGIS Desktop: The Basics of ArcView, ArcEditor, and ArcInfo Updated for ArcGIS 9*. ESRI Press.

### **Other References**

Students are encouraged to consult several transportation books/journals in the library or elsewhere, including (but not limited to) the following:

1. Gorr, W. L. and K. S. Kurland. (2005) *GIS Tutorial: Workbook for ArcView 9.0*. ESRI Press.
2. Kennedy, M. (2006) *Introducing Geographic Information Systems with ArcGIS*. John Wiley & Sons, Inc.

**Prerequisite:** CEGR 2101 – Engineering Drawing, AutoCAD, or consent of the instructor, graduate student status.

## Grading

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

Grade will be estimated from the following:

Assignments / mini-projects	25%
Exams	25%
Term project	50% (Written report and in-class oral presentation)
	<u>100%</u>

## Class Attendance

Students are expected to attend all class meetings for the course. Any missed attendance should receive prior authorization from the instructor except under extenuating circumstances. It is the student's responsibility to obtain information pertaining to class discussions, announcements made, lecture notes or handouts distributed during any missed session(s) - please make arrangements with your classmates and check course website for this. Students with unauthorized absences from class meetings risk having their final score for the course dropped by 0.5 points for every unauthorized absence from class meetings.

Please turn off all cellular phones, beepers, etc. that make audible sounds when in class. If you are expecting an EXTREMELY URGENT call or signal, please have the courtesy to discuss the same with the instructor and other students prior to the start of the class session and obtain the instructor's permission to leave your communication device turned on for the duration of that class session.

Please refrain from coming late, leaving in the middle of the class, walking in and out of the class room, or eating in the class since it tends to distract others in the room. If you have to eat for health reasons, do without disturbing others and clean up & dispose of any litter you create while eating at the end of the class period and prior to leaving the class room.

## Submission of written work

Please document all of your work (assignments, reports, etc.) as completely as possible. Your writing should be as professional in quality as possible. Each question (even if it is a "problem") must be accompanied by at least one sentence summarizing your findings. All pages of an assignment or submission must be stapled together, be in a legible and well-organized format. *Submissions must also include the following information on the first page:*

*Name*

*Assignment number*

*Date of submission*

*Time Spent in Hours*

It is better for you to submit whatever work you have completed at the time that the work is due and then submit work that you complete after this time as a late submission (rather than turning all the work as a late submission).



### **Honor Code**

*All students are expected to follow the honor code - submit only your original work! Students are expected to work individually on their assignments, unless otherwise instructed by the instructor in the assignment description. Students may discuss the assignment problems (interpretation of the questions, procedures to be used, etc.) in groups. Students may use such discussions to better understand the question or alternative methods of addressing the problem. However, the final submission **must** be the result of the student's individual effort. Please be sure to provide proper credit (citations) where appropriate. Penalties for violating standards of academic integrity could be severe and are stated in the "UNC Charlotte Code of Student Academic Integrity".*

### **Late Submission Policy**

The assignments will be due at the start of the lecture period on the dates specified when they are handed out or posted on the course website. In general, you will have at least 7 days to work on each assignment. Assignments submitted late will be accepted at the discretion of the instructor and would carry penalties (a minimum penalty of 10 percent for one day; penalty increases with the lateness of your submission). Late submissions will not be accepted after solutions have been posted or discussed in class.

### **Other UNC Charlotte Policies**

#### ***Disability***

If you have a disability that qualifies you for academic accommodations, please provide a letter of accommodation from the Office of Disability Services in the beginning of the semester. The Office of Disability Services is located in Fretwell Building, Room # 230. The phone # is 704-687-4355 (Voice/TTY).

#### ***Religious Holidays***

Any student missing class or lab work because of observance of religious holidays shall be given an opportunity during the semester to make up missed work. Please notify your instructor of anticipated absences at least one week in advance to be assured of this opportunity.

#### ***Absences due to Official UNC Charlotte Activity***

Students who represent UNC Charlotte at any official extracurricular activity shall have the opportunity to make up assignments, but the student must provide official written notification to the instructor no less than one week prior to missed class(es).

### **Course Outline**

1. Introduction
2. Recap of basic GIS concepts
  - a. Layers and features
  - b. Creating Maps (symbols, labels, legend, scale bar, and north arrow)
  - c. Building geodatabases
  - d. Digitizing and Geocoding or addressmatching
  - e. Querying data and joining tables

f. Conversion and projection

3. Preparing data for Civil Engineering applications
4. Analyzing spatial data for modeling and analysis of Civil Engineering problems
5. Internet mapping applications for engineering project data sharing and management
6. Case study on modeling air quality emissions
7. Case study on identifying high crash locations
8. Case study on extracting data using geospatial methods and develop (crash) prediction models

## **CEGR 6164 Traffic Safety**

### **Proposed and to be taught by:**

**Dr. Srinivas S. Pulugurtha, Associate Professor of Civil & Environmental Engineering**

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

**CEGR 6164: Traffic Safety. (3). Prerequisites: CEGR 3161 – Introduction to Transportation Engineering or consent of the instructor, graduate student status.** Crash data elements and source of data; Quantifying risk; Crash site reconstruction; 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. (*Fall, alternate years*)

**# Credit Hours: 3**

**Frequency:** Offered alternate fall semester

**Instruction Method:** Lecture

### **Course Objectives**

The objectives of the course are to:

1. educate students about the importance of traffic safety, and,
2. have students develop skills to address safety problems using analytical tools and techniques.

By the end of the course, students are expected to:

1. have an understanding of safety issues,
2. knowledge of crash data elements,
3. have skills to identify safety problems, high crash zones/ locations, and potential safety countermeasures,
4. rank and prioritize high crash zones / locations, and,
5. be able to evaluate the effectiveness of safety improvement projects.

### **Selected References**

1. Highway Safety Manual. Federal Highway Administration, Website: <http://safety.fhwa.dot.gov/hsm/>.
2. Evans, Leonard (2004) "Traffic Safety", Science Serving Society, Bloomfield Hills, Michigan.
3. Ogden, K. W. (1996) "Safer Roads: A Guide to Road Safety Engineering", Ashgate Publishing Company, Brookfield, Vermont.
4. Fatality Analysis Reporting System (FARS), National Highway Traffic Safety Administration.
5. Safety Analyst. Federal Highway Administration, Website: <http://www.safetyanalyst.org/>.

**Prerequisite:** CEGR 3161 – Introduction to Transportation Engineering or consent of the instructor, graduate student status.

### **Grading**

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

Grade will be estimated from the following:

Assignments	20%
Exams / Field Studies	20%
Term Project	60% (Written report and in-class oral presentation)
	<u>100%</u>

### **Course Outline**

1. Introduction
2. Safety, crash, and types of crashes
3. Categories of crashes
4. Measurement of risk - metrics
5. Road design standards
6. Vehicle related characteristics
  - a. Mass and size
  - b. Occupant protection devices
7. Human factors - Driver related characteristics
  - a. Gender and age
  - b. Performance and behavior
  - c. Contributing factors and collision types
  - d. Temporal and spatial distributions
8. Human factors - Pedestrian related characteristics
  - a. Gender and age
  - b. Pedestrian action
  - c. Temporal and spatial distributions
9. Data elements and sources
  - a. Who are involved in crashes?
  - b. Where (spatial distributions) are crashes occurring?
  - c. What are the contributing factors?
  - d. What are the collision types?
  - e. When (temporal variations) are they occurring?
10. Crash site reconstruction (forensic engineering)
11. Identify problem areas and hazardous locations
12. Measurement of risk, ranking and prioritization
13. Crash prediction and modeling
14. Treatments and countermeasures
15. Evaluation of safety treatments and countermeasures
16. Other topics (safety conscious planning, road audits, ...)

### **Class Attendance**

Students are expected to attend all class meetings for the course. Any missed attendance should receive prior authorization from the instructor except under extenuating circumstances. It is the student's responsibility to obtain information pertaining to class discussions, announcements made, lecture notes or handouts distributed during any missed session(s) - please make arrangements with your classmates. Students with unauthorized absences from class meetings risk having their final score for the course dropped by 0.5 points for every unauthorized absence from class meetings.

Turn off all cellular phones, beepers, etc. that make audible sounds when in class. If you are expecting an EXTREMELY URGENT call or signal, please have the professional courtesy to discuss the same with the instructor and other students prior to the start of the class session and obtain the instructor's permission to leave your communication device turned on for the duration of that class session.

Refrain from coming late, leaving in the middle of the class, walking in and out of the classroom during the class, or eating in the class since it tends to distract others in the room. If you have to eat for health reasons, do without disturbing others and clean up and dispose of any litter you may create while eating at the end of the class period and prior to leaving the class room. Students coming late to the class, leaving in the middle of the class or walking in and out of class meetings risk having their final score for the course dropped by 0.5 points for every such unauthorized instance.

### **Submission of written work**

Document all of your work (assignments, reports, data used for analysis, source of data used, etc.) as completely as possible. Your writing should be as professional in quality as possible. Each question (even if it is a "problem") must be accompanied by at least one sentence summarizing your findings. All pages of an assignment or submission must be stapled together, be in a legible and well-organized format. *All submissions must include the following information on the first page:*

*Name*

*Assignment number or report title*

*Date of submission*

*Time Spent in Hours*

It is better for you to submit whatever work you have completed at the time that the work is due and then submit work that you complete after this time as a late submission (rather than turning in all the work as a late submission).

### **Honor Code**

*All students are expected to follow the honor code - submit only your original work! Students are expected to work individually on their assignments, unless otherwise instructed by the instructor in the assignment description. Students may discuss the assignment problems (interpretation of the questions, procedures to be used, etc.) in groups. Students may use such*

discussions to better understand the question or alternative methods of addressing the problem. However, the final submission **must** be the result of the student's individual effort.

Provide proper credit (citations) where appropriate (includes data that you did not collect but gathered from various sources and used in analysis).

The instructor reserves the right to request any information that was used but was not documented in submitted assignments or reports. Failure to provide such information will have an effect on your course grade.

Penalties for violating standards of academic integrity could be severe and are stated in the "UNC Charlotte Code of Student Academic Integrity".

### **Late Submission Policy**

The assignments will be due at the start of the lecture period on the dates specified when they are handed out or distributed electronically. In general, you will have at least 7 days to work on each assignment. Assignments submitted late will be accepted at the discretion of the instructor and would carry penalties (a minimum penalty of 10 percent for one day; penalty increases with the lateness of your submission). Late submissions will not be accepted after solutions have been posted or discussed in the class.

### **Other UNC Charlotte Policies**

#### ***Disability***

If you have a disability that qualifies you for academic accommodations, provide a letter of accommodation from the Office of Disability Services at the beginning of the semester. The Office of Disability Services is located in Fretwell Building, Room # 230. The phone # is 704-687-4355 (Voice/TTY).

#### ***Religious Holidays***

Any student missing class or lab work because of observance of religious holidays shall be given an opportunity during the semester to make up missed work. Please notify well in advance (at least a week) of anticipated absences to be assured of this opportunity.

#### ***Absences due to Official UNC Charlotte Activity***

Students who represent UNC Charlotte at any official extracurricular activity shall have the opportunity to make up assignments, but the student must provide official written notification to the instructor no less than one week prior to missed class(es).

## CEGR 6243 Physical Processes in Environmental Systems

**Proposed and to be taught by:**

**Dr. James Bowen, Associate Professor of Civil & Environmental Engineering**

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

**CEGR 6243: Physical Processes in Environmental Systems. (3). Prerequisites: CEGR 3141, CEGR 3143, MATH 2171, graduate student status.** Environmental Engineering Processes. Physical Processes in Environmental Systems. 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.

**# Credit Hours: 3**

**Frequency:** Offered every fall semester

**Prerequisites:** CEGR 3141, CEGR 3143, MATH 2171.

**Instruction Method:** Lecture

### **Textbooks and Other Materials**

Readings will be taken from several textbooks on material transport in soils, surface waters, and the atmosphere. These texts are listed below.

- Chapra, Steven W., 2008. Surface Water Quality Modeling. Waveland Press. ISBN 978-1-57766-605-9. 844 pp.
- Clark, Mark M. 2009. "Transport Modeling for Environmental Engineers and Scientists, 2d edition." ISBN: 978-0-470-26072-2. Wiley, New York, NY, 664 pp.
- Fetter, C. W. 2001. Applied Hydrogeology, Fourth Edition, Prentice Hall, Upper Saddle River New Jersey.
- Fischer, Hugo B, E. John List, Robert C.Y. Koh, Jorg Imberger, Norman H. Brooks., Mixing in Inland and Coastal Waters.1979. Academic Press, San Diego, CA.
- Streeter, Victor L, Wylie, E. Benjamin, and Bedford, Keith W. 1998. Fluid Mechanics, Ninth Edition, WCB McGraw-Hill, Boston, MA. 740 pp.
- Bird, R. Byron, Warren E. Stewart, and Edwin N Lightfoot. 1960. Transport Phenomenon. John Wiley and Sons. New York, NY. 780 pp.

### **Grading and Exams**

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

Grade will be estimated from the following:

There will be two in-class exams, either in-class or take-home, during the semester and one comprehensive in-class final examination.

Exams = 25%, 30% = 55%

Homeworks = 10%

Final (covers all of class) = 35%

Total = 100%

### Student Conduct

All materials submitted for grades (e.g. test and final problems, homework assignments) must represent the student's original work. Students may discuss homework problems, including comparing answers. Copying another student's work, or copying a solutions manual is strictly forbidden. It is the responsibility of every student to know and observe the requirements of the UNCC Code of Student Academic Integrity. This code forbids cheating, fabrication or falsification of information, multiple submissions of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty. Any student violating the code will be subject to the penalties described in this document. If in doubt, please ask before you engage in any activity about which you are unsure.

UNC Charlotte Academic Integrity Page Students are responsible for meeting all class deadlines (e.g. completing homework assignments, taking tests and finals). No make-up exams are scheduled except for very special situations. Students must appear at the designated time to take in-class tests and finals to receive any credit, unless **prior** approval is granted for an alternate time. You will not be granted alternate test or final times afterwards.

### Course Outline and Schedule

Home-work	Class	Topics	Reading Assignment
	1	Class Introduction, Administration, Fluid Movement Processes in Soil, Water, Air 1, Introduction	Streeter, Wylie, Bedford (SWB), Ch. 4.1, pp. 185-195, Bird, Stewart, Lightfoot (BSL), pp. 71-74
	2	Fluid Movement Processes in Soil, Water, Air 2 Mass Balances, Systems Approach	BSL pp. 74-76, Clark pp. 1-4, 10-14, 18-20, SWB 196-198
	3	Fluid Movement Processes in Soil, Water, Air 3, Mass Balances Differential Approach 1/2	Fetter, Ch. 4
	4	Fluid Movement Processes in Soil, Water, Air 4, Mass Balances Differential Approach 2/2	
Hwk. 1 due	5	Fluid Movement Processes in Soil, Water, Air 5, Momentum Balance 1/2	
	6	Fluid Movement Processes in Soil, Water, Air 6, Momentum Balances 2/2	
	7	Fluid Movement Processes in Soil, Water, Air 7, Energy Balance	
	8	Fluid Movement Processes in Soil, Water, Air 8, Groundwater Flow 1/2	
Hwk. 2 due	9	Fluid Movement Processes in Soil, Water, Air 9, Groundwater Flow 2/2	
		Advection-Diffusion Equations	



		in Soil, Water Air 1	
Hwk. 3 due	10	Advection-Diffusion Equations in Soil Water, Air 2	
	11	<b>Test 1, Lectures 1 – 9</b>	
	12	Diffusion Processes in Groundwater 1	
Hwk. 4 due	13	Turbulent Diffusion in Water, Air 1	
	14	JB out of town, no class	
		JB out of town, no class	
	15	Shear Dispersion in Water, Air 1	
	16	Shear Dispersion in Water, Air 2	
Hwk. 5 due	17	Transport Across Air/Water Interface 1	
	18	Transport Across Air/Water Interface 2	
		<b>Test 2, Classes 10-16</b>	
	19	Settling and Resuspension of Particles 1	
	20	Settling and Resuspension of Particles 2	
Hwk. 6 due	21	Transport Measurement Methods in Soil, Water, Air 1	
	22	Transport Measurement Methods in Soil, Water, Air 2	
	23	Transport Measurement Methods in Soil, Water, Air 3	
	24	Transport Measurement Methods in Soil, Water, Air 4	
Hwk. 7 due	25	Review	
		<b>Final</b>	

## CEGR 6244 Chemical Fate and Transport

### Proposed and to be taught by:

Dr. John Daniels, Associate Professor of Civil & Environmental Engineering

### Graduate Catalog – Information and Description

**CEGR 6244: Chemical Fate and Transport. (3).** Prerequisites: CEGR 3141 – Environmental Engineering I, graduate student status. Fate of chemicals in the environment and transport processes within and between phases; Environmental chemodynamics; Volatilization, dissolution and adsorption from an equilibrium perspective; Evaluation of mass transfer kinetics across environmental compartments. (*On demand*)

**# Credit Hours:** 3

**Frequency:** On demand.

**Prerequisites:** CEGR 3141 – Environmental Engineering I, graduate student status.

**Instruction Method:** Lecture

### Textbooks and Other Materials

- Environmental Chemodynamics, Movement of Chemicals in Air, Water and Soil, 2<sup>nd</sup> Edition, Louis J. Thibodeaux, John Wiley and Sons, 1996.

### Grading and Exams

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

Grade will be estimated from the following:

Exams 1 & 2:	30% each
Homework:	25%
Paper Presentation	15%
Total =	100%

### Course Outline

- Reaeration of Natural Streams
- Equilibrium at Environmental Interfaces I
- Equilibrium at Environmental Interfaces II
- Sorption and Diffusion
- Film Theory
- Chemical Exchange: Air and Water I
- Chemical Exchange: Air and Water II
- Chemical Exchange: Sea Surface Slicks
- Chemical Exchange: Water and Earthen Material
- Chemical Exchange: Air and Earthen Material
- Chemical Exchange: Evaporation and Diffusion through Soil Pores
- Fugacity 1 & 2, computer exercise

## CEGR 6245 Chemical & Biological Processes in Environmental Systems

**Proposed and to be taught by:**

**Dr. James Amburgey, Associate Professor of Civil & Environmental Engineering**

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

#### **CEGR 6245: Chemical and Biological Processes in Environmental Systems. (3)**

Prerequisites: CHEM 1251, CEGR 3141, graduate student status. 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. (*Fall*)

**# Credit Hours:** 3

**Frequency:** Offered every fall semester

**Prerequisites:** CHEM 1251, CEGR 3141, graduate student status.

**Instruction Method:** Lecture

#### **Approach/Philosophy**

Many graduate environmental engineering programs (e.g., Georgia Tech) begin with all of the students being required to take 3 separate courses in their first semester that cover the FUNDAMENTAL concepts necessary for graduate level research and coursework. One course is physical processes, which covers reactors, reactions, reaction orders, advection, dispersion, diffusion, mass balances, and related physical processes. A second course is chemical processes (or environmental chemistry) which covers ideality, kinetics, thermodynamics, equilibrium, chemical reactions, acid/base behavior, chemical speciation, pC-pH diagrams, the carbonate system (buffering), and related chemical processes. The third course is biological processes (or environmental microbiology), which covers topics like types of microorganisms, their requirements for growth & survival, natural biological cycles (e.g., the carbon cycle), photosynthesis, models to predict the growth & decay of microorganisms, and related biological processes.

This course will cover some of the most important topics from 2 of the 3 areas listed previously in a single course. This course will empower you with the fundamental knowledge and skills necessary to for understanding environmental systems & your environment, taking upper level environmental courses, and functioning efficiently in an environmental research laboratory. Of course, physical, chemical, and biological process principles apply to & control almost every system in the world.

#### **Course Text:**

Mihelcic, J.R. 1999. *Fundamentals of Environmental Engineering*. John Wiley & Sons, Inc., NY, NY. ISBN: 0471243132.

**Other Potential Resources:**

1. Snoeyink, V. L., and Jenkins, D., Water Chemistry, Wiley, New York, 1980.
2. Benjamin, M.M., Water Chemistry, McGraw-Hill, New York, 2002.
3. APHA, AWWA, and WEF. *Standard Methods for the Examination of Water and Wastewater*, 20<sup>th</sup> ed. 1998. APHA, Washington, D.C.
4. Davis, M.L., and D.A. Cornwell. 1998. *Introduction to Environmental Engineering*, 3<sup>rd</sup> Ed., McGraw-Hill, Boston, MA.

**Grading**

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

Grade will be estimated from the following:

Assignment	Percent of Course Grade
Homework	10
Project(s)	10
Exam #1	25
Exam #2	25
Final Exam	30

**Expectations**

I have some expectations of you that go beyond the obvious things like turning in homework, and I thought it would be useful to make these explicit also. The first expectation is that you are curious. I will ask lots of questions in this class and I hope and expect you to do the same. My second expectation is that you, individually and as a group, will be both learners and teachers. I want you to learn from each other, teach each other, and teach me. My third expectation is that you come to class prepared!

**Course Outline**

Subject	Assignments/Other
1. Introduction & Overview	Read Pgs. 1-9
2. Manipulating units, concentrations in liquid & air, and the ideal gas law	Read Pgs. 11-20
3. Molarity, Normality & Equivalent units	Read Pgs. 21-36
4. CHEM1: Ideality, activity, ionic strength	Read Pgs. 43-48
5. CHEM2: Kinetics & (0 & 1 <sup>st</sup> order) Reaction Rates	Read Pgs. 49-56
6. CHEM3: Kinetics Applications	Read Pgs. 49-56
7. CHEM4: Half-life, temperature effects, and catalysts	Read Pgs. 57-62
8. CHEM5: Thermodynamics (free energy) & Equilibrium	Read Pgs. 63-75
9. CHEM LAB1: Tea Time (Thermodynamics/Kinetics)	
10. CHEM6: Equilibrium Processes (Henry's Law)	Read Pgs. 76-85
11. CHEM7: Acid-Base Chemistry (pH & Equilib. Consts.)	Read Pgs. 86-92
12. CHEM8: Carbonate system, alkalinity, & Buffering	Read Pgs. 93-102
13. CHEM LAB2: pH measurement	*Read paper

16. CHEM9: Solubility, Sorption & Ion Exchange	Read Pgs. 103-120
17. CHEM10: Oxidation & Reduction (Redox)	Read Pgs. 121-129
18. BIOL1: <i>tentative</i> : Ecosystems & Microorganisms	Read Pgs. 209-217
19. BIOL2: <i>tentative</i> : Population Dynamics & Growth	Read Pgs. 217-224
20. BIOL3: <i>tentative</i> : Monod model	Read Pgs. 224-236
21. BIOL4: <i>tentative</i> : Energy flow & microbial energetics	Read Pgs. 237-248
22. BIOL5: <i>tentative</i> : Oxygen Demand (DO, BOD, COD...)	Read Pgs. 248-273
23. BIOL6: <i>tentative</i> : Material flow (H <sub>2</sub> O, C, O, N, P, S cycles)	Read Pgs. 273-291
24. BIOL7: <i>tentative</i> : Lakes, nutrients, & Eutrophication	Read Pgs. 291-300
25. BIOL8: <i>tentative</i> : Health & Welfare: toxicity & indicators	Read Pgs. 300-310

### Homework

Homework is due at the beginning of the 2<sup>nd</sup> class period after it is assigned (unless otherwise noted). Homework must be handed in at the beginning of class and late homework will not be accepted (without a prior agreement).

Learning is the principal objective of any course. I expect to learn a lot this semester from you, I expect (hope) you to learn from me, and I expect you to learn from each other. Because of the latter expectation, I have no objections to people working together in small groups (2 or 3 people), **provided it is a mutual learning experience for all involved.**

Direct copying of another's work is not allowed, nor is dividing an assignment two or three ways and exchanging papers later. If one person has already solved a problem, and you have put in a good-faith effort on it but still cannot solve it, it is acceptable for that person to teach you how to solve it, but not acceptable for him to simply give you his/her paper as a guide.

**Academic integrity violations, including plagiarism:** All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online at:

<http://www.legal.uncc.edu/policies/ps-105.html>

IF YOU HAVE ANY QUESTIONS ABOUT WHAT IS OR IS NOT ACCEPTABLE FOR THIS COURSE, THEN PLEASE SEE THE INSTRUCTOR BEFORE TURNING IN YOUR WORK. The policy on cheating is no tolerance & no second chances. Whenever you legitimately use the work, ideas, or help of others, please document it on the submitted assignment.

**Use of cell phones, beepers, or other communication devices in the classroom:** Please put all electronic devices in "silent" or "vibrate" mode prior to entering the classroom. The use of cell

phones, beepers, or other communication devices during class is disruptive, and is therefore prohibited. In case of an emergency, those using such devices must leave the classroom.

**Attendance**

Class attendance is not required, but failure to attend class could be hazardous to your learning experience. So, please arrive on time and be prepared to participate in class.

**Orderly and productive classroom conduct:** I will conduct this class in an atmosphere of mutual respect. I encourage your active participation in class discussions. Each of us may have strongly differing opinions on the various topics of class discussions. The conflict of **ideas** is encouraged and welcome. The orderly questioning of the ideas of others, including mine, is similarly welcome. However, I will exercise my responsibility to manage the discussions so that ideas and argument can proceed in an orderly fashion. You should expect that if your conduct during class discussions seriously disrupts the atmosphere of mutual respect I expect in this class, you will not be permitted to participate further.

**Makeup work:** Makeup assignments or exams will not be given, unless a prior agreement is reached between the student and the instructor.

**Agreement to terms and conditions set forth herein:** If you do not agree to these terms and conditions, then you risk losing the opportunity to participate in this course. Please contact the instructor immediately or withdraw from this course if you do NOT agree to the terms and conditions of this syllabus.

## **CEGR 6251: ANALYSIS AND DESIGN OF DEEP FOUNDATIONS**

**Proposed and to be taught by:**

**Dr. Miguel A. Pando, Associate Professor of Civil & Environmental Engineering**

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

**CEGR 6251. Analysis and Design of Deep Foundations. (3). Prerequisites: CEGR 3278 - Geotechnical Engineering I or consent of the instructor, graduate student status.** 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. *(Fall)*

**# Credit Hours:** 3

**Frequency:** Offered every fall semester

**Prerequisites:** CEGR 3278 - Geotechnical Engineering I or consent of the instructor, graduate student status.

### **Course Objectives**

The primary objective of this course is to gain an understanding of the analysis and design of deep foundations. Another objective is to critically assess project design considerations and geotechnical site conditions to select and design a suitable deep foundation system. Another objective is to learn deep foundation modeling software that is commonly used in geotechnical engineering practice.

By the end of the course, students will be able to:

1. Identify different deep foundation systems including their characteristics, advantages, limitations, and applications.
2. Appraise civil engineering project requirements and conditions in relation to the selection of appropriate deep foundation system alternatives for a project.
3. Design and interpret pile load tests.
4. Perform analysis and design of driven piles including driveability analyses (WEAP), prepare pile driving recommendations, and be familiar with PDA and CAPWAP.
5. Perform analysis and design of drilled shafts.
6. Perform analysis and design of micropiles and other specialty deep foundations (ACIP, fundex, etc).
7. Utilize deep foundation design software (e.g., Driven, A-pile, LPILE, Group, FB-Pier, etc).
8. Design deep foundations for uplift, negative skin friction effects, scour, seismic loading, and other special design considerations.

**Instructional Method:** Lecture

## Grading

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

Grade will be estimated from the following:

Item	Percentage of Final Grade
Quizzes (2 to 4)	10 %
Homeworks	20 %
Term Paper and Presentation	20%
Midterm Test	20 %
Final Exam	30 %

## Course Textbook

There is no single course textbook. The course material will consist on course handouts and references which will be posted in the course Moodle page (Transferring to Moodle 2 in Progress).

Some useful references for this course which will be posted include:

- FHWA (1998), “Design and Construction of Driven Pile Foundations Reference Manual”, Publication No. FHWA HI 97-013 and 97-014 (Volumes I&II).
- FHWA (2010), “Drilled Shafts: Construction Procedures and LRFD Design Methods”, Publication No. -NHI-10-016.
- FHWA (2007), “Design and Construction of Continuous Flight Auger Piles ”, FHWA Geotechnical Engineering Circular No. 8.

## Important Course Policies

### *Classroom Expectations*

This syllabus contains the policies and expectations I have established for CEGR 6090/INES8090 – Analysis and Design of Deep Foundations (Deep Foundations). Please read the entire syllabus carefully before continuing in this course. These policies and expectations are intended to create a productive learning atmosphere for all students. Unless you are prepared to abide by these policies and expectations, you risk losing the opportunity to participate further in the course.

### **Classroom Environment**

I will conduct this class in an atmosphere of mutual respect. I encourage your active participation in class discussions. Each of us may have strongly differing opinions on the various topics of class discussions. The conflict of ideas is encouraged and welcome. The orderly questioning of the ideas of others, including mine, is similarly welcome. However, I will exercise my responsibility to manage the discussions so that ideas and argument can proceed in an orderly fashion. You should expect that if your conduct during class discussions seriously disrupts the atmosphere of mutual respect I expect in this class, you will not be permitted to participate further.



### ***Academic Integrity***

All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online (<http://legal.uncc.edu/policies/up-407>).

You have the responsibility to know and observe the requirements of the UNC Charlotte Code of Student Academic Integrity. This code forbids cheating, fabrication or falsification of information, multiple submissions of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty. This includes falsifying attendance records.

### ***Advanced Notice about Use of Plagiarism Detection Program***

As a condition of taking this course, papers that the instructor in good faith suspects are in whole or in part plagiarized may be subject to submission for textual similarity review to Turnitin.com for the detection of plagiarism. Such works will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. No student papers will be submitted to Turnitin.com without a student's written consent and permission (Please fill out and sign Consent Form provided). If a student does not provide such written consent and permission, the instructor may: (i) require a short reflection paper on research methodology; (ii) require a draft bibliography prior to submission of the final paper; or (iii) require the cover page and first cited page of each reference source to be photocopied and submitted with the final paper.

### **Attendance Policy**

**Attendance is extremely important and expected. It is also your responsibility to obtain missed information when you are absent.**

### **Class Etiquette**

You will be asked to leave and will be counted absent if you:

- Do not arrive on time.
- Eat in classroom.
- Read newspapers or magazines.
- Do homework in class.
- Unauthorized use of your laptop.
- Use your cell phone or listen to a music device or text messages.
- Are disruptive or disrespectful.

***About Cell Phones and Smart Phones:*** *The use of cell phones, smart phones, or other mobile communication devices is disruptive, and is therefore prohibited during class. Except in emergencies, those using such devices must leave the classroom for the remainder of the class period.*

### ***Minimum Time Expectations for this 3-credit Graduate Course***

*This 3 credit course requires 3 hours of direct faculty classroom instruction and about 6 hours of out-of-class student work each week for approximately 15 weeks. Out-of-class work may include*

but is not limited to: *REQUIRED READING, LIBRARY RESEARCH, WRITTEN ASSIGNMENTS, AND STUDYING FOR QUIZZES AND EXAMS.* Please ensure you budget enough hours per week to study and do out-of-class work for this course.

### **Late Assignments**

All assignments are expected to be submitted during class time on their assigned date. **Late homeworks will not be accepted.**

Requests for exception to this policy due to medical or other emergency require appropriate documentation (e. g., doctor's note). This course will utilize a "**Stuff Happens**" Card to allow students one exception for the late submission of one assignment. You may turn in the work up to 24 hours after the due date using this card, After 24 hours you will not be able to submit later assignment.

### **Attendance to examinations**

Students are required to attend all examinations. If a student is absent from an examination for a justifiable reason acceptable to the professor, he or she will be given a special examination. Otherwise, he or she will receive a grade of zero in the examination missed.

### **Course notifications**

Make sure you check the *Moodle* site for the course periodically and check your university e-mail address.

### **Mid-term Unsatisfactory Grades**

You will receive plenty of feedback at regular intervals in this course to allow you to assess your progress. Remember there is no TA in this course so all the grading will be done by me. If you are uncertain how well you are doing please feel free to come and see me during office hours or by appointment.

### **Course Outline**

<b>Week:</b>	<b>Topic:</b>
1	Syllabus. Introduction, Deep foundation definitions, Axial load transfer process
2	Overview of driven piles and drilled shafts, construction methods and considerations.
3	Static methods driven piles
4	Static methods drilled shafts
5	Software DRIVEN, SPT97
6	Settlement of single piles, and pile groups
7	Settlement of pile groups (continued); Software FB-Pier
8	Uplift of piles. Note: 10/11 No Class – Student Recess (Fall break)
9	Negative skin friction
10	Midterm exam; and Driven piles allowable stresses
11	Driven piles: Dynamic formulae, Wave Equation Analysis; Software GRLWEAP; PDA
12	Driven piles: CAPWAP; Pile load tests

13	Lateral loaded piles. P-y curves, Software LPILE and FB-Pier.
14	General loading conditions.
15	Specialty deep foundations: micropiles, ACIP, Fundex, etc.
16	LRFD design of deep foundations.
17	Last Class: Final term papers due and presentations (during class period)
	Final Exam (all-inclusive – duration: 2.5 hours; 13:00 – 15:30)

**(\*): Schedule subject to change based on potential project site visits and guest lectures.**

## CEGR 6253 Design of Waste Containment Systems

**Proposed and to be taught by:**

**Dr. Vincent Ogunro, Associate Professor of Civil & Environmental Engineering**

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

**CEGR 6253. Design of Waste Containment Systems. (3). Prerequisites: Consent of the instructor, graduate student status.** Types and function of containment systems; Selection of effective containment system and its design; Design and analysis of landfills, grout curtains and slurry walls; Degradation mechanisms and monitoring of containment systems. (*Fall*)

**# Credit Hours:** 3

**Frequency:** Offered every fall semester

### **Prerequisites**

- An introductory course in soil mechanics or geology
- Proficiency in simple computational methods.

### **Course Objectives**

At the conclusion of this course, students should be able to:

- Apply relevant policies and specifications to the design of waste containment systems.
- Analyze containment system performance requirements.
- Develop approaches to gather required data, select the potentially effective containment systems and measure their performance.
- Understand the functions of different components of a containment system, and formulate numerical methods for assessing their functional capacity.
- Apply the concepts learned to numerically analyze the stability and contaminant transport through components of systems such as landfills, slurry walls, grout curtains, surface impoundments, tanks and cryogenic barriers.

### **Textbook and References**

Considering that this course involves some techniques that have been developed only within the past few years, no single textbook will suffice. Reference materials are drawn from a significant number of recent technical guidance documents of agencies such as the U.S. Environmental Protection Agency (U.S.EPA) and the Department of Energy (U.S.DOE); and from open technical literature. Additional reading assignments will be given from the following text.

- *Geoenvironmental Engineering, Principles and Applications*, 2000. Lakshmi N. Reddy and Hilary I. Inyang, Marcel Dekker, Inc., ISBN 0-8247-0045-7

**Instructional Method:** Lecture

## Grading

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

Grade will be estimated from the following:

Term paper .....	10%
Homework.....	10%
Midterm Exam.....	40%
Final Exam .....	40%

## Course Content

### 1. Regulations And Policies That Pertain To Systems Design:

- U.S. EPA Regulations And Policies On Waste Containment
- Design Factors, Containment Decision Support Systems
- Policies And Programs Of Other Agencies On Waste Containment
- Technical Issues And Related Disciplines

### 2. Types And Functions Of Containment Systems:

- Waste Containment Structures As Multi-Component Systems
- Configurations Of The Most Common Containment Systems
- Qualitative And Quantitative Relationships Between Risk, Pollutant Release And Design Aspects
- Factor Of Safety And Probabilistic Design Approaches
- Fundamental Concepts Of Risk, Hazard And Reliability As They Apply To Waste Containment Systems

### 3. Selection Of Potentially Effective Containment System:

- Site Characterization
- Categories Of Required Data And Their Sources (Hydrological Data, Hydrogeological Data, Geotechnical Data And Waste Data)
- Measures Of Performance Effectiveness

### 4. Design And Analysis Of Landfills:

- General Configuration And Approach
- Design Of Cover Systems: general functions and design configurations of cover systems; design standards; cover erosivity analysis; analysis of sliding stability of cover systems; drainage layer evaluation and design; assessment of long-term settlement effects; geomembrane and geotextile applications; assessment of planar stresses in geomembranes analysis of the stability of cover soils above geomembranes
- Design And Analysis Of Liner Systems: review of simple advection relationships; analysis of simple transit without retardation; analysis of simple transit with suction including the green-ampt wetting front model; analysis of simple transit with retardation
- The One-Dimensional Advection Dispersion Equation: general numerical configuration and its application to barrier systems; analysis of the most common one-dimensional transport models, including solutions of relevant differential equations; approximate solutions for severely damaged barriers

### 5. Design And Analysis Of Grout Curtains And Slurry Walls:

- Introduction To Rheological Properties Of Grouts: practical significance of rheological parameters; analogy between grout permeation of soils and grout flow in pipes; introduction to grouting methods; monitoring of grout performance
  - Types Of Slurry Walls And Their Performance Requirements: stability and flow computations for slurry walls; some slurry wall case histories
6. Other Containment Systems:
- Groundwater Extraction Systems; Design Of Cryogenic Barriers; Application Of Peripheral Dynamic Compaction To Leachate Containment; And Use Of Ground Water Coverage Schemes To Inhibit The Infiltration Of Surface Water
7. Degradation Mechanisms And Improvement And Monitoring Of Containment Systems:
- Waste Containment System Deterioration Mechanisms: introduction to structural and material textural changes in barriers; mineral crystallization, dissolution and leaching; approaches to improvement of barrier systems; containment attenuation processes and their enhancement; use of admixtures in barriers; monitoring techniques and technologies for waste containment systems.

## CEGR 6254: Experimental Soil Mechanics

### Proposed and to be taught by:

Dr. Miguel A. Pando, Associate Professor of Civil & Environmental Engineering

### Graduate Catalog – Information and Description

**CEGR 6254. Experimental Soil Mechanics. (3). Prerequisites: CEGR 3278 - Geotechnical Engineering I or consent of the instructor, graduate student status.** Experimental methods, with emphasis on laboratory tests, to determine engineering soil properties and investigate soil behavior; i) classification tests (i.e., used to identify soil classification and identify general engineering behavior type); and ii) 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 triaxial, cyclic triaxial, 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. (*Spring*)

**# Credit Hours:** 3

**Frequency:** Offered every spring semester

**Objectives:** Students are expected to be able to perform standard and advanced geotechnical laboratory tests, reduce and interpret test results and data, design experimental programs for applied and research problems, and write publication quality reports.

**Outcomes:** After attending this course students will be able to:

- Select, perform, and interpret adequate geotechnical tests for different soil types and design conditions,

### **Instructional Method:** Lecture

This course meets at a specified time every week. However, some weeks you will have to coordinate to work outside these times to complete lab assignments or homeworks.

Most weeks we will start with a short review lecture. The objective of these initial lectures is to cover the main theory, but most weeks which involve standard undergraduate lab tests you are expected to do independent readings. The short lecture period will be followed by independent or guided lab sessions or experiments at the various geotechnical laboratories in EPIC. Please make sure that you indicate whether you have access to the main geotech labs in EPIC with your UNCC ID Card. If not we will need to request access for you (**please check this the first week of classes**).

### **Textbook and Other Resources**

No specific text is required in this class. Will receive handouts, pdf copies of presentations, articles, etc. A useful textbook, but not required is: Bardet, J.P. (1997), *Experimental Soil Mechanics*, Prentice Hall, 583 p.

However, students are expected to download the U.S. Army Corps of Engineers Laboratory Soils Testing (see link below for USACOE manual). Course materials and handouts will be posted in the Moodle site assigned for this course. Handouts, ASTM Standards, data reduction sheets and other pertinent information can be found on this web page as well.

**Other Useful References:**

- 1) USACOE Laboratory Soil Testing Manual:  
<http://140.194.76.129/publications/eng-manuals/em1110-2-1906/toc.htm>
- 2) ASTM Standards available online from UNCC library.
  - Know the proper soil specimen handling and preparation procedures for geotechnical testing.
  - Know the critical techniques required to conduct and present results of consolidation, permeability, and shear strength tests.
  - Know techniques to eliminate and reduce critical testing errors.

**Grading:**

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

Grade will be estimated from the following:

Homeworks	15 %
Lab reports	40 %
Quizzes	5%
Project	20 %
Final Exam	20 %
Total	100 %

**Honor Code:** The UNCC Code of Academic Integrity will be enforced.  
<http://www.legal.uncc.edu/policies/ps-105.html>

**Assignments and Lab Reports:**

The assignments must be submitted in letter report format, similar to the fashion that test results are submitted by an engineering firm to a client (See page 3)). They will be graded based on technical content and accuracy, and also on the quality of the writing.

**Project:**

The project for this semester will entail a geotechnical report for a small industrial facility. We will be using the field data from the drilling demonstration. Students will prepare a geotechnical report that must include the sections typically included in a geotechnical report (including, project description and scope, site location, geology, field testing, lab testing, soil conditions, engineering recommendations (foundations, earth work, etc), and other sections you consider necessary for this project. This project will count for 20% of the grade of this course.

**Final Exam:**

All inclusive final examination that will focus primarily on theory and background of the different tests covered throughout the semester.



### **Additional notes concerning Lab Test Reports (individual and group reports)**

Besides the transmittal memo/letter; and particularly for the group lab reports, the report shall include the following sections (prepared in ASCE conference proceeding style):

#### **Introduction**

The introduction section sets the stage as to why we are doing this experiment or research. Problem statement. Example: (1) CRS tests provide an alternative to conventional tests for finding parameters to calculate magnitude & rate of settlement. But are the results compatible? or (2) What is the effect of stress path? (3) What is the effect of gradient on coefficient of permeability?

#### **Purpose and Scope**

This section states objectives and "what was done to achieve this objective". Example: The purpose of this permeability test was to determine values for  $k$ , and evaluate the effects of gradient and flow direction on  $k$  values. These objectives were achieved by performing a double burette (ASTM D5084) test using various gradients and flow directions.

The introduction, purpose and scope, should tell the reader WHY (problem), objective, and WHAT/ HOW experiment was done.

#### **Literature Review**

For this section, present a brief review of those references that you will refer to in data analysis, or background you feel the reader should have to understand the report. However, omit BASICS! Example: Carpenter and Stephenson (1885) observed that  $k$  decreased as  $i$  increased, which is contrary to Darcy's Law. Do Not explain Darcy's Law.

#### **Material (Soil), Test Equipment, and Procedure**

A brief description on soil type, i.e., classification, visual description, grain-size curves. Specimen preparation- Compacted, undisturbed, pluviated, water contents, densities  
Test equipment & Procedure - Refer to ASTM or USACOE specs wherever possible, and where necessary note exceptions.

#### **Presentation and Analysis of DATA**

Make use of summary tables and graphs to present results and make "points" that will be in analysis of data. Place raw data in appendix. Alibis go here. Back-up each spread-sheet with example hand calculations.

#### **Conclusions**

1. Be concise
2. Each conclusion should be backed-up in data analysis section
3. For every purpose, there must be a conclusion

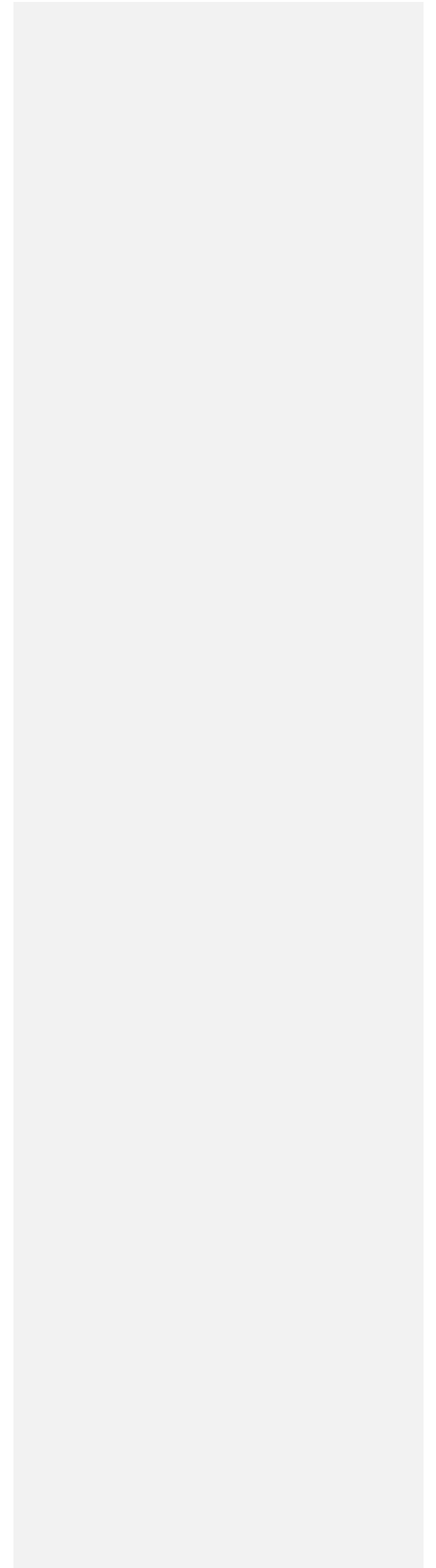
#### **References**

Use ASCE style.

## Course Outline

- Measurement techniques:
  - Common lab equipment and instrumentation
  - Electronic transducers,
  - calibration,
  - data acquisition systems.
- Classification and Index tests (Week 2): (Prior to Week 2 please review undergraduate notes and relevant references, and ASTM Standards)
  - Moisture content
  - Particle size distribution (sieving, sedimentation theory, hydrometer)
  - Atterberg limits
  - Specific Gravity
  - Sample density
  - Visual classification and descriptions.
- Chemical tests:
  - pH
  - Sulphate content, Organic content, Carbonate content, Chloride content, Others.
- Drilling and sampling techniques:
  - Drilling Demonstration
  - “*Undisturbed specimens*” from thin walled tubes
  - “*Undisturbed specimens*” from block samples
  - Reconstituted samples (e.g., compacted, air or water pluviated, sedimentation, etc.)
- Compaction tests:
  - Definitions, theory
  - Compaction procedures (e.g., Standard and Modified Proctor, etc).
  - Field tests
  - Discussion (Suction, crushing of particles, other factors).
- Permeability tests:
  - Definitions, theory
  - Indirect methods
  - Direct methods (constant head and falling head, using triaxial device)
- Direct shear tests:
  - Definitions, theory
  - ASTM D3080 methodology
  - Other shear tests (simple shear, ring shear, etc.)
- Triaxial testing:
  - Introduction, conventional apparatus, modern setup, strain
  - Unconfined compression
  - Backpressure saturation techniques
  - UU, CU, CD, and advanced stress paths
  - Recent advances: frictionless ends, local strain and/or pore pressure measurements.
- Compressibility tests:
  - Introduction, consolidation theory
  - Oedometer test as per ASTM D 2435

- Constant strain rate consolidation (CRS test)
- Cyclic triaxial
- Cyclic simple shear.
- Resonant column testing and other advanced tests.



## CEGR 6255 Soil Stability and Earth Structures

**Proposed and to be taught by:**

**Dr. Miguel A. Pando, Associate Professor of Civil & Environmental Engineering**

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

**CEGR 6255. Soil Stability and Earth Structures. (3). Prerequisites: CEGR 3278 - Geotechnical Engineering I or consent of the instructor, graduate student status.** 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. (*Spring*)

**# Credit Hours:** 3

**Frequency:** Offered every spring semester

**Prerequisites:** CEGR 3278 - Geotechnical Engineering I or consent of the instructor, graduate student status. Students are expected to have knowledge in geotechnical engineering principles, geology, and fluid mechanics. Completion of the graduate course on shear strength of soils or equivalent is recommended.

### **Course Objectives**

By the end of this course, the students will be able to assess the stability of natural and man-made soil slopes and identify possible mitigation techniques or schemes for unstable slopes. The student will be able to analyze seepage and ground water for slope stability problems.

Specific objectives of the course include:

- Student should be able draw seepage flow nets for isotropic and anisotropic soils.
- Student should be able perform seepage analyses for slopes and dams using a finite element commercial software (e.g., Seep/W or equivalent).
- Student should be able analyze the stability of a soil slopes and embankment dams using limit equilibrium analyses and finite element analyses. This includes static and dynamic analyses as well as stability and deformation assessment under different design conditions (e.g., short term, long term, rapid draw down, seismic, etc).
- Student should be aware of different stabilization techniques that can be used for unstable slopes.

**Instructional Method:** Lecture

**Grading**

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

Grade will be estimated from the following:

- Assignments and Quizzes = 20%
- Project = 25%
- Midterm exam = 25%
- Final Exam = 30%

**Final Exam:** TBD as per academic calendar and registrar final exam schedule.

**Course Textbook:**

There is no single course textbook. The course material will consist on course handouts and references which will be posted in the course Moodle 2 page. Instruction will be supplemented by references listed in supplementary handouts provided by instructor and by assigned lesson readings.

Useful textbooks (complimentary but not required):

- Duncan, J.M. and Wright, S.G. (2005). Soil Strength and Slope Stability. Wiley & Sons, 1st Edition, ISBN 0-471-69163-1.
- Abramson, L.W., Lee, T.S., Sharma, S, and Boyce, G.M. (2002). Slope Stability and Stabilization Methods. Wiley & Sons, 2nd Edition, ISBN 0-471-38493-3.

**Important Course Policies*****Classroom Expectations***

This syllabus contains the policies and expectations I have established for CEGR 6090/INES8090 – Slope Stability and Earth Structures. Please read the entire syllabus carefully before continuing in this course. These policies and expectations are intended to create a productive learning atmosphere for all students. Unless you are prepared to abide by these policies and expectations, you risk losing the opportunity to participate further in the course.

***Classroom Environment***

I will conduct this class in an atmosphere of mutual respect. I encourage your active participation in class discussions. Each of us may have strongly differing opinions on the various topics of class discussions. The conflict of ideas is encouraged and welcome. The orderly questioning of the ideas of others, including mine, is similarly welcome. However, I will exercise my responsibility to manage the discussions so that ideas and argument can proceed in an orderly fashion. You should expect that if your conduct during class discussions seriously disrupts the atmosphere of mutual respect I expect in this class, you will not be permitted to participate further.

### ***Academic Integrity***

All students are required to read and abide by the Code of Student Academic Integrity. Violations of the Code of Student Academic Integrity, including plagiarism, will result in disciplinary action as provided in the Code. Definitions and examples of plagiarism are set forth in the Code. The Code is available from the Dean of Students Office or online (<http://legal.uncc.edu/policies/up-407>).

You have the responsibility to know and observe the requirements of the UNC Charlotte Code of Student Academic Integrity. This code forbids cheating, fabrication or falsification of information, multiple submissions of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty. This includes falsifying attendance records.

### **Advanced Notice about Use of Plagiarism Detection Program**

As a condition of taking this course, papers that the instructor in good faith suspects are in whole or in part plagiarized may be subject to submission for textual similarity review to Turnitin.com for the detection of plagiarism. Such works will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. No student papers will be submitted to Turnitin.com without a student's written consent and permission (Please fill out and sign Consent Form provided). If a student does not provide such written consent and permission, the instructor may: (i) require a short reflection paper on research methodology; (ii) require a draft bibliography prior to submission of the final paper; or (iii) require the cover page and first cited page of each reference source to be photocopied and submitted with the final paper.

### **Attendance Policy**

Attendance is extremely important and expected. It is also your responsibility to obtain missed information when you are absent.

### **Class Etiquette**

You will be asked to leave and will be counted absent if you:

- Do not arrive on time.
- Eat in classroom.
- Read newspapers or magazines.
- Do homework in class.
- Unauthorized use of your laptop.
- Use your cell phone or listen to a music device or text messages.
- Are disruptive or disrespectful.

***About Cell Phones and Smart Phones:*** *The use of cell phones, smart phones, or other mobile communication devices is disruptive, and is therefore prohibited during class. Except in emergencies, those using such devices must leave the classroom for the remainder of the class period.*

### ***Minimum Time Expectations for this 3-credit Graduate Course***

*This 3 credit course requires 3 hours of direct faculty classroom instruction and about 6 hours of out-of-class student work each week for approximately 15 weeks. Out-of-class work may include but is not limited to: REQUIRED READING, LIBRARY RESEARCH, WRITTEN*

*ASSIGNMENTS, AND STUDYING FOR QUIZZES AND EXAMS. Please ensure you budget enough hours per week to study and do out-of-class work for this course.*

**Late Assignments**

All assignments are expected to be submitted during class time on their assigned date. . **Late homeworks will not be accepted.**

Requests for exception to this policy due to medical or other emergency require appropriate documentation (e. g., doctor’s note). This course will utilize a **“Stuff Happens” Card** to allow students one exception for the late submission of one assignment. You may turn in the work up to 24 hours after the due date using this card, After 24 hours you will not be able to submit later assignment.

**Attendance to examinations**

Students are required to attend all examinations. If a student is absent from an examination for a justifiable reason acceptable to the professor, he or she will be given a special examination. Otherwise, he or she will receive a grade of zero in the examination missed.

**Course notifications**

Make sure you check the *Moodle* site for the course periodically and check your university e-mail address.

**Mid-term Unsatisfactory Grades**

You will receive plenty of feedback at regular intervals in this course to allow you to assess your progress. Remember there is no TA in this course so all the grading will be done by me. If you are uncertain how well you are doing please feel free to come and see me during office hours or by appointment.

**TENTATIVE LIST OF TOPICS (\*)**

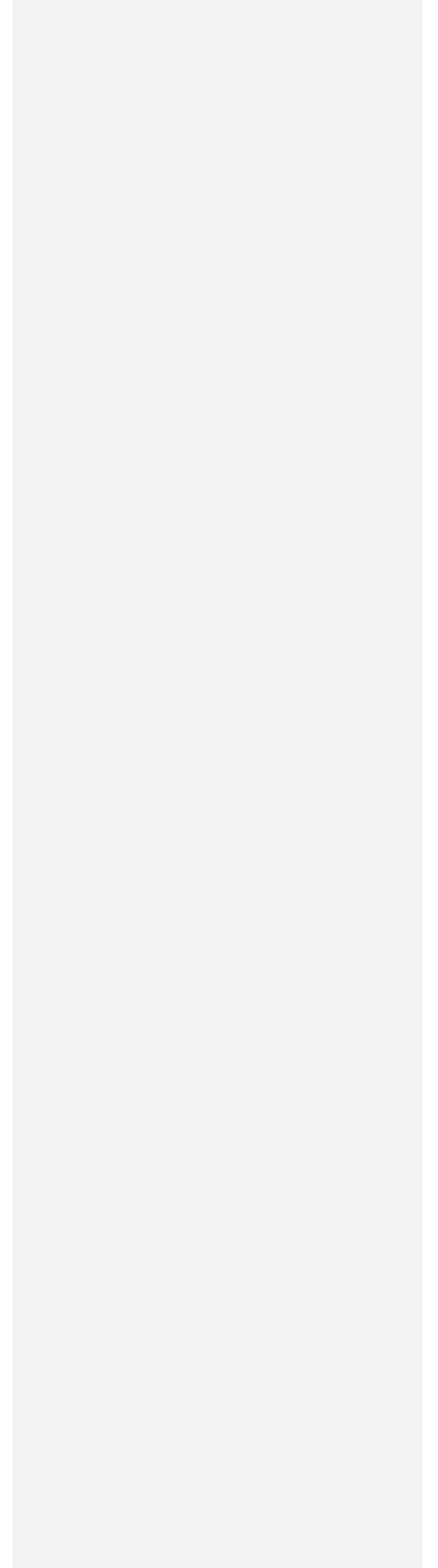
<b>Topics</b>	<b>Contact hours</b>
1. Introduction Course objectives and scope, introduction to slope stability problem.	1.25
2. Overview of slope stability problem: approach, considerations, limitations, etc	1.25
3. Review of Seepage applied to slope stability problems	2.5
4. Review of Shear Strength of soils and rocks for slope stability problems	2.5
5. Limit equilibrium analysis for slope stability problems: General considerations, limit equilibrium versus deformation, filosofy of factor of safety.	1.5
6. Infinite slope analyses Dry, parallel and inclined seepage.	1
7. Wedge model analysis	1
8. Conventional limit equilibrium methods Circular failure surfaces, Swedish method, ordinary method of slices, modified Swedish, Bishop method, modified Bishop method, Janbu,	6

and modified Janbu.	
9. Software, searching techniques, simplified stability charts	4.5
<b>TEST 1</b>	<b>1</b>
10. Advanced limit equilibrium methods Spencer, Morgenstern-price, others	<b>4.5</b>
11. Detailed guidelines to select shear strength parameters, water effects.	<b>3</b>
12. Deformation analysis of slopes and dams: Limitations of limit equilibrium analyses. Deformations, strain compatibility, and finite element analyses.	<b>4.5</b>
13. Back-analysis Principles of back-analysis, learning from slope failures, variability and uncertainty of back-analysis models.	<b>1.5</b>
14. Landslides in tropical climates	<b>3</b>
15. Special Considerations for Design of Earth dams and Embankments	<b>3</b>
16. Seismic Stability of Slopes	<b>3</b>
<b>Total contact hours:</b>	<b>45</b>

(\*): Schedule subject to change based on potential project site visits and guest lectures.



## **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

<http://cee.uncc.edu>

### Graduate Program Director

Dr. Srinivas S. Pulugurtha

### Graduate Program Student Services Specialist

Adrienne Threatt

### Graduate Faculty

James E. Amburgey, Associate Professor

James D. Bowen, Associate Professor

Shen-en Chen, P.E., Professor

John L. Daniels, P.E., Interim Department Chair and Associate Professor

[Wei Fan, P.E., Associate Professor](#)

Janos I. Gergely, S.E., P.E., Associate Professor

Edd Hauser, Professor

~~Hilary I. Inyang, Duke Energy Distinguished Professor~~

Rajaram Janardhanam, Professor

Martin R. Kane, P.E., Associate Professor

Olya Keen, Assistant Professor

[Milind Khire, P.E., Professor](#)

Sara McMillan, Assistant Professor

David Naylor, P.E., Lecturer

Vincent O. Ogunro, Associate Professor

Miguel A. Pando, Associate Professor

Youngjin Park, Faculty Associate

Srinivas S. Pulugurtha, P.E., Associate Professor

William Saunders, P.E., Lecturer

Brett Q. Tempest, Assistant Professor

Kimberly A. Warren, Associate Professor

David C. Weggel, P.E., Associate Professor

Matthew J. Whelan, Assistant Professor

Jy S. Wu, P.E., P.H., Professor

David Young, P.E., Professor

*P.E. = Professional Engineer*

*P.H. = Professional Hydrologist*

*S.E. = Structural Engineer*

### **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 and structural materials
- 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 of certain deficiencies as specified by 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 or MSE programs at UNC Charlotte.

### 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 to their published application deadlines. 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. However, the Department will continue to evaluate applications for admission provided the application is complete for admission consideration as determined by the Graduate School.

### Assistantships

Research and teaching assistantships are available from the Department on a competitive basis to highly qualified applicants/students.

### 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 research 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.

### Track Descriptions/Requirements

Required core courses for the various tracks are listed below, as well as additional recommended courses for each study track.

~~*[Editor's Note: Are there course numbers/titles that correspond with the below highlighted required courses that can be included instead of generic descriptions?]*~~

#### **Environmental and Water Resources Engineering**

*Environmental Engineering*

CEGR 5142 Water/Wastewater Engineering (3)

CEGR 5143 Solid Waste Management (3)

CEGR 6141 Water Quality Modeling (3)

~~*Water Treatment Engineering (3)*~~ **CEGR 6243 Physical Processes in Environmental Systems (3)**

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

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*Water Resources*

- CEGR 6141 Water Quality Modeling (3)
- CEGR 6146 Advanced Groundwater Analysis (3)
- CEGR 6147 Watershed Modeling (3)
- CEGR 6149 Watershed Analysis (3)
- CEGR 6173 Environmental Aquatic Chemistry (3)

*Environmental Management*

- ~~CEGR 5237 Environmental Risk Management (3)~~
- ~~Natural Disasters (3)~~
- ~~ISO Management Systems (3)~~
- ~~Environmental Impact Assessment (3)~~
- ~~EMGT 6902 Legal Issues in Engineering Mgmt (3)~~  
or ~~EMGT 6950 Engineering Systems Integration (3)~~

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**Geo-Environmental Engineering**

Required core courses:

- CEGR 5145 Groundwater Resources Engineering (3)
- ~~CEGR 6253 Design and Analysis of Waste Containment Systems (3)~~
- ~~Soil and Groundwater Remediation (3)~~

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**Geotechnical Engineering**

Required core courses:

- CEGR 5145 Groundwater Resources Engineering (3)
- CEGR 5270 Earth Pressures and Retaining Structures (3)
- CEGR 5278 Geotechnical Engineering II (3)
- CEGR 6268 Advanced Soil Mechanics (3)
- ~~CEGR 6251 Analysis and Design of Deep Foundations Engineering (3)~~
- ~~CEGR 6254 Experimental Soil Mechanics (3)~~

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Additional recommended courses:

- ~~CEGR 5264 Landfill Design and Site Remediation (3)~~
- CEGR 5271 Pavement Design (3)
- CEGR 5272 Design with Geosynthetics (3)
- ~~CEGR 5273 Soil Improvement (3)~~
- ~~CEGR 5274 Site Characterization (3)~~
- CEGR 6146 Advanced Groundwater Analysis (3)
- CEGR 6252 Soil Dynamics and Earthquake Engineering (3)
- ~~Soil Improvement and Site Characterization (3)~~

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**Structural Engineering or Structural Materials**

Required core courses:

- 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)

Additional recommended courses for the two tracks in Structural Engineering are:

*Structural Analysis and Design*

CEGR 5121 Prestressed Concrete Design (3)  
CEGR 5123 Bridge Design (3)  
CEGR 6124 Masonry Design (3)  
CEGR 6126 Analysis of Plates and Shells (3)  
CEGR 6127 Fracture Mechanics and Fatigue (3)  
CEGR 6128 Structural Optimization (3)  
[CEGR 5125](#) Forensic Engineering (3)  
[CEGR 5223](#) Timber Design (3)

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*Structural Materials*

CEGR 6127 Fracture Mechanics and Fatigue (3)  
MEGR 6141 Theory of Elasticity I (3)  
~~Composite Materials (3)~~  
[CEGR 6125](#) Structural Strengthening (3)

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**Transportation Engineering**

Required core courses:

CEGR 5161- Advanced Traffic Engineering (3)  
[CEGR 5162 Transportation Planning \(3\)](#)  
[CEGR 5185 Geometric Design \(3\)](#)

CEGR 6161- Traffic Control and Operation (3)

~~And one of the following:~~

GEOG 6100- Quantitative Methods in Geography (3)  
~~MATH 6107 Linear Algebra (3)~~  
~~MATH 6172 Advanced Applied Mathematics II (3)~~

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

### **Electives**

With advisor approval, a maximum of two graduate courses (outside CEGR or within CEGR) in a study area different from the student's focus area 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 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. A graduate faculty member (CEGR or non-CEGR) from outside the student's major area-of-study 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; 27 credit hours of coursework plus 3 credit hours of a directed project; or 30 credit hours of coursework plus a written 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.

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 will 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 will measure the student's mastery of theories and

applications in core courses and/or in the selected area of specialization within the discipline. Students will have only two attempts to pass the examination. All students passing the written examination will be 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 (<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. (*Fall*)

**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. (*Spring*) (*Alternate years*)

**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. (*Spring*) (*Alternate years*)

**CEGR 5125. Forensic Engineering. (3).** Prerequisite: CEGR 3122 and permission of department—~~Structural Analysis I, or consent of the instructor, graduate student status.~~ 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;

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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. (Fall, alternate years)

**CEGR 5126. Codes, Loads, and Nodes. (3).** Prerequisite: CEGR 3122 ~~and permission of department—Structural Analysis I, with a grade C or better, graduate student status.~~ 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. (Fall)

**CEGR 5127. Green Building and Integrative Design. (3).** Prerequisite: CEGR 3122 ~~and permission of department—Structural Analysis I, or consent of the instructor, graduate student status.~~ Course topics prepare 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. (Fall)

**CEGR 5142. Water/Wastewater 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. (Spring)

**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. (Spring) (Alternate years)

**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. (Fall) (Alternate years)

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**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. *(Fall)*

**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 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. *(Fall)*

**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. *(Spring)*

**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. *(Alternate years)*

**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. *(Fall) (Alternate years)*

**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. *(Fall) (Alternate years)*

**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. *(Spring)*

**CEGR 5223. Timber Design. (3).** Prerequisite: CEGR 3122 —~~Structural Analysis I, or consent of the instructor, graduate student status and permission of department.~~ **PRINCIPLES OF TIMBER DESIGN-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. *(Fall)***

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**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. *(Fall)*

**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. *(Spring)*

**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 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 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. *(Spring)*

**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. *(Spring) (Alternate years)*

**CEGR 5270. Earth Pressures and Retaining Structures. (3)** Prerequisites: CEGR 3122, CEGR 3278, CEGR 4278, and permission of the department. Co-requisite: CEGR 4278 can be a co-requisite. 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. *(Fall)*

**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. Co-requisite: CEGR 4278 can be a co-requisite. 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. (*Spring*)

**CEGR 5273. Soil Improvement. (3).** Prerequisites: ~~CEGR 3278 –Geotechnical Engineering I~~ ~~or consent of the instructor, graduate student status 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. (*Spring*)

**CEGR 5274. Site Characterization. (3).** Prerequisites: ~~CEGR 3278 –Geotechnical Engineering I~~ ~~or consent of the instructor, graduate student status 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). (*Fall*)

**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. (*Spring*)

**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*)

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**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. *(Spring) (Alternate years)*

**CEGR 6125. Structural Strengthening. (3)** Prerequisite: [CEGR 3221, CEGR 3225, and permission of department—Structural Steel Design I and CEGR 3225—Reinforced Concrete Design I, with a grade C or better, graduate student status.](#) [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.](#) *(Spring)*

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**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<sup>al</sup> 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. *(Spring)*

**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. *(Alternate years)*

**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. *(Spring)*

**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. *(Fall)*

**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. *(Spring)*

**CEGR 6162. Computer Applications for Transportation Engineers. (3). Prerequisites:**  
**CEGR 3161 —Introduction to Transportation Engineering or consent of the instructor, graduate student status and permission of department. Apply analytical techniques using traffic simulation and transportation planning software to evaluate various transportation facilities; Emphasis on**

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computer applications and software packages such as HCS, SYNCHRO/SimTraffic, and VISSIM; 4-Step planning process using TransCAD; Build mathematical models. (Spring, alternate years)

**CEGR 6163. GIS for Civil Engineers. (3).** Prerequisites: CEGR 2101 —~~Engineering Drawing, AutoCAD, or consent of the instructor, graduate student status and permission of department.~~ Apply Geographic Information System (GIS) tools to solve Civil Engineering problems: add layers, label, & symbolize features, create maps in ArcMap, generate tables & spatial databases, address matching, query & join tables, perform spatial overlays, generate buffers, and conduct spatial analysis. Civil Engineering case studies. (Fall, alternate years)

**CEGR 6164: Traffic Safety. (3).** Prerequisites: CEGR 3161 —~~Introduction to Transportation Engineering or consent of the instructor, graduate student status 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. (Fall, alternate years)

**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 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)

**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, CHEM 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. (Spring) (Alternate years)

**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)

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**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 6243: Physical Processes in Environmental Systems. (3).** Prerequisites: CEGR 3141, CEGR 3143, MATH 2171, ~~graduate student status~~ and permission of department. Environmental Engineering Processes. Physical Processes in Environmental Systems. 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. (Fall)

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**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)

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**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. (Fall)

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**CEGR 6251. Analysis and Design of Deep Foundations. (3).** Prerequisites: CEGR 3278 and ~~permission of department; Geotechnical Engineering I or consent of the instructor; graduate student status.~~ 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. (Fall)

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**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 6253. Design and Analysis of Waste Containment Systems. (3).** Prerequisites: ~~permission of department; Consent of the instructor; graduate student status.~~ Types and function of containment systems; Selection of effective containment system and its design; Design and

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analysis of landfills, grout curtains and slurry walls; Degradation mechanisms and monitoring of containment systems. (Fall)

**CEGR 6254. Experimental Soil Mechanics. (3).** Prerequisites: CEGR 3278 –~~Geotechnical Engineering I or consent of the instructor, graduate student status and permission of department~~ permission of department. Experimental methods, with emphasis on laboratory tests, to determine engineering soil properties and investigate soil behavior; i) classification tests (i.e., used to identify soil classification and identify general engineering behavior type); and ii) 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. (Spring)

**CEGR 6255. Soil Stability and Earth Structures. (3).** Prerequisites: CEGR 3278 –~~Geotechnical Engineering I or consent of the instructor, graduate student status 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. (Spring)

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**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. (Fall)

**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. (Fall)

**CEGR 6892. Individualized Study and Projects. (1-6)** Prerequisite: permission of department. Individual investigation or exposition of results for the 3-hour MS project. May be repeated for credit. (Fall, Spring, Summer)

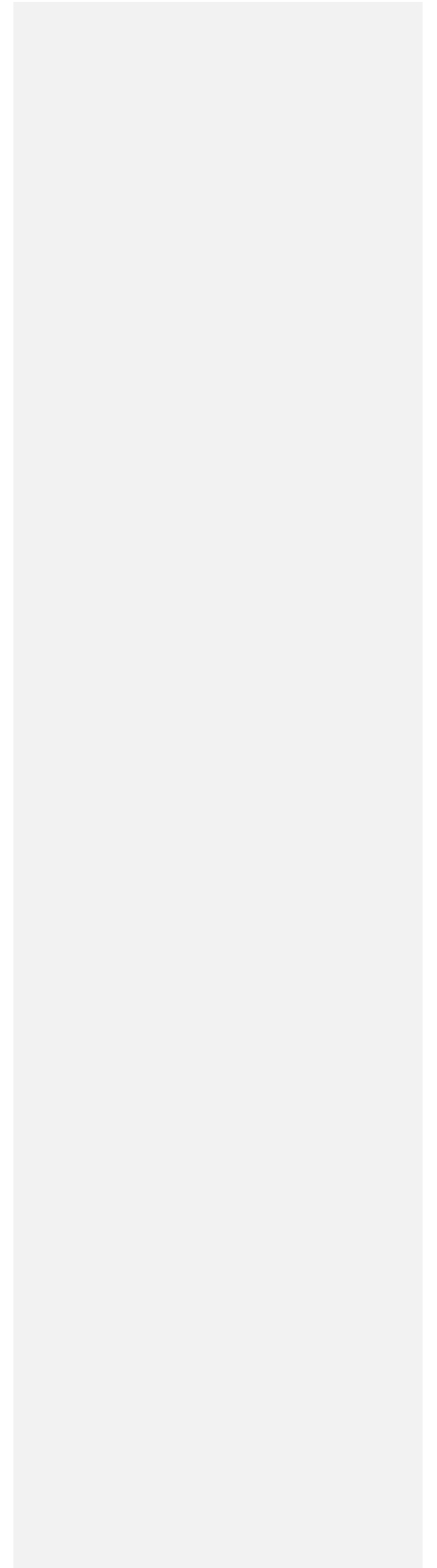
**CEGR 6990. Industrial Internship. (1-3)** Prerequisite: Completion of nine hours of graduate coursework. Full- or part-time academic year internship in engineering complementary to the major course of studies and designed to allow theoretical and course-based practical learning to be applied in a supervised 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 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: David Young  
From: Alison Bradley  
Date: 11/13/13  
Subject: CEGR 5125 -- Forensic Engineering

Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley Date: 11/13/13

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), particularly as it has been successfully offered as a special topics course for several semesters and requires limited independent research. Students will have access to relevant databases such as ASCE CEDB, Compendex, Risk Abstracts, and many others.

LC Subject Heading	Books	Journals
Forensic engineering	23	0
Structural failures	99	1
Building failures	44	1

*Alison Bradley*

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Evaluator's Signature

11/13/13

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Date



J. Murrey Atkins Library

Consultation on Library Holdings

To: Janos Gergely
From: Alison Bradley
Date: 11/13/13
Subject: CEGR 5126 – Codes, Loads, and Nodes

Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley Date: 11/13/13

Check One:

- 1. Holdings are superior
2. Holdings are adequate (checked)
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), particularly as it has been successfully offered as a special topics course for several semesters and does not require independent research. Students will have access to relevant databases such as ASCE CEDB, Compendex, the Avery Index, and many others.

Table with 3 columns: LC Subject Heading, Books, Journals. Rows include Standards, Engineering; Buildings – Specifications; Strains and stresses.

Alison Bradley

Evaluator's Signature

11/13/13

Date



J. Murrey Atkins Library

Consultation on Library Holdings

To: Brett Tempest  
From: Alison Bradley  
Date: 11/13/13  
Subject: CEGR 5127 – Green Building and Integrative Design

Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley Date: 11/13/13

Check One:

- 1. Holdings are superior
- 2. Holdings are adequate
- 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), particularly as it has been successfully offered as a special topics course for several semesters. Students will have access to relevant databases such as ASCE CEDB, Compendex, the Avery Index, Environment Complete, and many others.

LC Subject Heading	Books	Journals
Sustainable buildings	131	4
Sustainable architecture.	192	3
Sustainable construction	96	1
Buildings -- Energy conservation.	373	10

*Alison Bradley*

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Evaluator's Signature

11/13/13

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Date



J. Murrey Atkins Library

Consultation on Library Holdings

To: David Weggel
From: Alison Bradley
Date: 11/13/13
Subject: CEGR 5223 Timber Design

Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley Date: 11/13/13

Check One:

- 1. Holdings are superior
2. Holdings are adequate (checked)
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), particularly as it has been successfully offered as a special topics course for several semesters. Students will have access to relevant databases including ASCE Digital Library, ScienceDirect, Web of Science, Compendex, and many others.

Table with 3 columns: LC Subject Heading, Books, Journals. Rows include Building, Wooden; Structural design; Timber; Wood.

Alison Bradley

Evaluator's Signature

11/13/13

Date



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J. Murrey Atkins Library

Consultation on Library Holdings

To: Vincent Ugunro  
From: Alison Bradley  
Date: 11/14/13  
Subject: CEGR 5273 Soil Improvement

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Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley Date: 11/14/13

Check One:

- 1. Holdings are superior
- 2. Holdings are adequate
- 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, ASCE CEDB, GeoRef, and many others.

LC Subject Heading	Books	Journals
Soil Mechanics	326	24
Engineering – Geology	179	31
Soil Stabilization	121	2

*Alison Bradley*

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Evaluator's Signature

11/14/13

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Date



J. Murrey Atkins Library

Consultation on Library Holdings

To: Vincent Ugunro
From: Alison Bradley
Date: 11/14/13
Subject: CEGR 5274 Site Characterization

Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley Date: 11/14/13

Check One:

- 1. Holdings are superior
2. Holdings are adequate (checked)
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). Although book and journal titles are limited, access to ASTM standards and other similar materials will be more important for research in this course. Articles and books not available directly from the library may be borrowed easily through Interlibrary Loan. Students will have access to relevant databases including the ASTM Digital Library, Compendex, GeoRef, ScienceDirect, and many others.

Table with 3 columns: LC Subject Heading, Books, Journals. Rows include Engineering geology and Environmental sampling.

Alison Bradley

Evaluator's Signature

11/14/13

Date



J. Murrey Atkins Library

Consultation on Library Holdings

To: Janos Gergely  
From: Alison Bradley  
Date: 11/14/13  
Subject: CEGR 6125 Structural Strengthening

Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley Date: 11/14/13

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 reference titles and databases including the International Building Code, NC Building Code, ASCE Digital Library, ASTM Digital Library, and many others.

LC Subject Heading	Books	Journals
Structural analysis	792	14
Buildings -- Specifications	84	11
Structural design	721	18

*Alison Bradley*

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Evaluator's Signature

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Date



J. Murrey Atkins Library

Consultation on Library Holdings

To: Srinivas Pulugurtha  
From: Alison Bradley  
Date: 11/14/13  
Subject: CEGR 6162 Computer Applications for Transportation Engineers

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Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley Date: 11/14/13

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 online resources including Transportation Research Record online, TRID, Compendex, ScienceDirect, and many others.

LC Subject Heading	Books	Journals
Traffic engineering	851	12
Transportation engineering	390	21
Highway capacity	61	0

*Alison Bradley*

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11/14/13

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Date



J. Murrey Atkins Library

Consultation on Library Holdings

To: Srinivas Pulugurtha

From: Alison Bradley

Date: 11/14/13

Subject: CEGR 6163 GIS for Civil Engineers

Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley Date: 11/14/13

Check One:

- 1. Holdings are superior
- 2. Holdings are adequate
- 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), although this will depend on their topics selected. Students will have access to relevant databases including Compendex, TRID, GeoRef, and many others.

LC Subject Heading	Books	Journals
Geographic information systems	489	31
Spatial analysis (Statistics)	88	3

*Alison Bradley*

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Evaluator's Signature

11/14/13

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Date



J. Murrey Atkins Library

Consultation on Library Holdings

To: Srinivas Pulugurtha  
From: Alison Bradley  
Date: 11/15/13  
Subject: CEGR 6164 Traffic Safety

Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley Date: 11/15/13

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 online resources including Transportation Research Record online, TRID, Compendex, ScienceDirect, and many others.

LC Subject Heading	Books and Documents	Journals
Traffic safety	1038	38
Traffic engineering	851	12
Roads Design and construction Safety measures	66	0

*Alison Bradley*

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Evaluator's Signature

11/15/13

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Date



J. Murrey Atkins Library

Consultation on Library Holdings

To: James Bowen
From: Alison Bradley
Date: 11/18/13
Subject: CEGR 6243 Physical Processes in Environmental Systems

Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley Date: 11/18/13

Check One:

- 1. Holdings are superior
2. Holdings are adequate (checked)
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 by subject heading below), particularly as it has been offered as a special topics course in the past. Students will have access to databases including ASCE Digital Library, ASFA: Aquatic Sciences and Fisheries Abstracts, GeoScienceWorld, Environment Complete, Web of Science, Compendex, and many others.

Table with 3 columns: LC Subject Heading, Books/Documents, Journals. Rows include Groundwater flow, Sedimentation, and Hydrogeology.

Alison Bradley

Evaluator's Signature

11/18/13

Date



J. Murrey Atkins Library

Consultation on Library Holdings

To: John Daniels  
From: Alison Bradley  
Date: 11/13/13  
Subject: CEGR 6244 Chemical Fate and Transport

Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley Date: 11/13/13

Check One:

- 1. Holdings are superior \_\_\_\_\_
- 2. Holdings are adequate \_\_\_\_\_
- 3. Holdings are adequate only if Dept. purchases additional items.   x
- 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), with additional support from existing book budgets. In the interim, access to materials through Interlibrary Loan will be sufficient for research needs that are not covered by current holdings.

Students will have access to relevant databases including Compendex, GeoRef, ScienceDirect, ASCE CEDB, Environment Complete, and many others.

LC Subject Heading	Books	Journals
Environmental Chemistry	105	19
Chemical Oceanography	57	1
Atmospheric chemistry	128	6

*Alison Bradley*

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Evaluator's Signature

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J. Murrey Atkins Library

Consultation on Library Holdings

To: James Amburgey  
From: Alison Bradley  
Date: 11/18/13  
Subject: CEGR 6245 Chemical & Biological Processes in Environmental Systems

Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley Date: 11/18/13

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), particularly as it requires limited independent research. Students will have access to relevant databases including Compendex, ScienceDirect, Environment Complete, and many others.

LC Subject Heading	Books	Journals
Water chemistry	301	5
Environmental engineering	854	90

*Alison Bradley*

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Evaluator's Signature

11/18/13

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Date



J. Murrey Atkins Library

Consultation on Library Holdings

To: Miguel Pando  
From: Alison Bradley  
Date: 11/18/13  
Subject: CEGR 6251: ANALYSIS AND DESIGN OF DEEP FOUNDATIONS

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Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley Date: 11/18/13

Check One:

- 1. Holdings are superior \_\_\_\_\_
- 2. Holdings are adequate  \_\_\_\_\_
- 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 ASTM Digital Library, Compendex, ASCE CEDB and Digital Library, and many others.

LC Subject Heading	Books	Journals
Foundations Design and construction	54	2
Soil mechanics	326	24
Piling (Civil engineering)	52	0

*Alison Bradley*

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Date



J. Murrey Atkins Library

Consultation on Library Holdings

To: Vincent Ugunro  
From: Alison Bradley  
Date: 11/18/13  
Subject: CEGR 6253 Design and Analysis of Waste Containment Systems

Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley Date: 11/18/13

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 ASTM Digital Library, ASCE CEDB and Digital Library, Environment Complete, Environmental Sciences and Pollution Management, and many others.

LC Subject Heading	Books/Documents	Journals
Hazardous waste site remediation	702	16
Sanitary landfills	10629	163
Hydrogeology	835	9

*Alison Bradley*

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Evaluator's Signature

11/18/13

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Date



J. Murrey Atkins Library

Consultation on Library Holdings

To: Miguel Pando  
From: Alison Bradley  
Date: 11/18/13  
Subject: CEGR 6254: Experimental Soil Mechanics

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Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley Date: 11/18/13

Check One:

- 1. Holdings are superior \_\_\_\_\_
- 2. Holdings are adequate  \_\_\_\_\_
- 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 ASTM Digital Library, Compendex, GeoRef, and many others.

LC Subject Heading	Books	Journals
Soil mechanics	326	24
Soils -- Testing	126	1
Soils -- Classification	43	0

*Alison Bradley*

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Evaluator's Signature

11/18/13

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Date



J. Murrey Atkins Library

Consultation on Library Holdings

To: Miguel Pando  
From: Alison Bradley  
Date: 11/18/13  
Subject: CEGR 6255 Soil Stability and Earth Structures

Summary of Librarian's Evaluation of Holdings:

Evaluator: Alison Bradley Date: 11/18/13

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, ASTM Digital Library, ASCE Digital Library and CEDB, GeoRef, and many others.

LC Subject Heading	Books	Journals
Soil mechanics	326	24
Soil stabilization	121	2
Slopes (Soil mechanics)	49	1

*Alison Bradley*

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Evaluator's Signature

11/18/13

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Date

## **APPENDIX D.**

